A 4-4-0 TENDER ENGINE FOR BEGINNERS

By MARTIN EVANS

This is the first article in a series which will describe an easily constructed spirit-fired locomotive

The ME gauge 1 steam locomotive

THIS 4-4-0 locomotive is of particular interest as its design is basically one of J. N. Maskelyne's dating back to 1924, though opportunity has been taken to bring certain parts, such as ports and valves, more into line with current practice. I have named it *Newbury* in recognition of J.N.M.'s association with that town.

Though free-lance, the design has a Southern flavour, and is straightforward and reasonably easy to build.

Methylated spirit firing is used, the boiler being of the usual high-pressure water-tube type, and the few castings required will be obtainable from our advertisers. A simple displacement lubricator, located between the frames ahead of the smokebox, should cope with the oil supply, and water feed will be taken care of by a hand pump in the tender.

All wheels are sprung, the driving wheels by single coil springs, and the bogie will have a simple form of laminated springing. No horns are specified, the frames, of $\frac{1}{16}$ in. thickness being sufficient for normal wear. So now to work.

MAINFRAMES

These are cut from $12\frac{1}{2}$ in. lengths of $\frac{1}{16}$ in. bright mild steel, $1\frac{1}{4}$ in. wide. One strip is marked out from the drawing, all holes drilled, and the marked strip bolted or riveted temporarily to the second strip for cutting out together.

The slots for the main axleboxes should be sawn and filed, using a piece of $\frac{1}{2}$ in. square brass bar (later to be used for axleboxes) as a gauge.

Only one frame stretcher is required and this is simply a $1\frac{5}{16}$ in. length of $\frac{1}{4}$ in. dia. b.m.s. drilled No 37 both ends, and tapped 5 BA.

The buffer beam and drag beam are cut from $\frac{1}{2}$ in. × $\frac{1}{2}$ in. × $\frac{1}{16}$ in. hard brass angle. Drill buffer holes No 21, and tap $\frac{3}{16}$ in. × 40 t.p.i. The 3/32 in. square hole for coupling is cut by first drilling with No 41 drill, then opening out with a small square needle file.

Coming now to the slots for the frames, these can be cut by means of a metal fretsaw (jeweller's type) with No M/O blade, two cuts being made to each slot, as near as possible to the scribed lines, finishing off with a flat needle file, using the frames themselves as a gauge.

The buffer-beam fixing angles are merely short lengths of $\frac{5}{16}$ in. × $\frac{5}{16}$ in. × $\frac{1}{16}$ in. brass angle riveted to the beam with $\frac{1}{16}$ in. copper rivets, and 6 BA steel cheesehead screws are used through No 34 holes in the frames into tapped holes in the angles.

The mainframes may now be assembled, a toolmaker's small clamp being used to hold the frames in position for drilling.

A hand drill is quite satisfactory for this, one hole being drilled and tapped without shifting the clamp. When all holes are drilled and tapped the frames should be placed on the surface plate or lathe bed for final assembly.

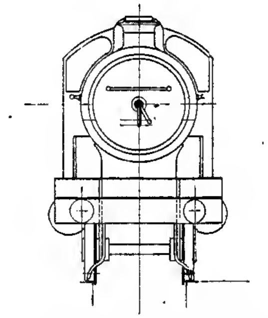
AXLEBOXES

As few constructors will have a milling machine available, a built-up axlebox is suggested, $\frac{1}{2}$ in. square brass bar being used and $\frac{1}{16}$ in. strip of suitable width to form the flange. Chuck sufficient $\frac{1}{2}$ in. square bar in the four-jaw, set to run true, centre, drill and open out to about 9/32 in. Part off to length ($\frac{3}{16}$ in.).

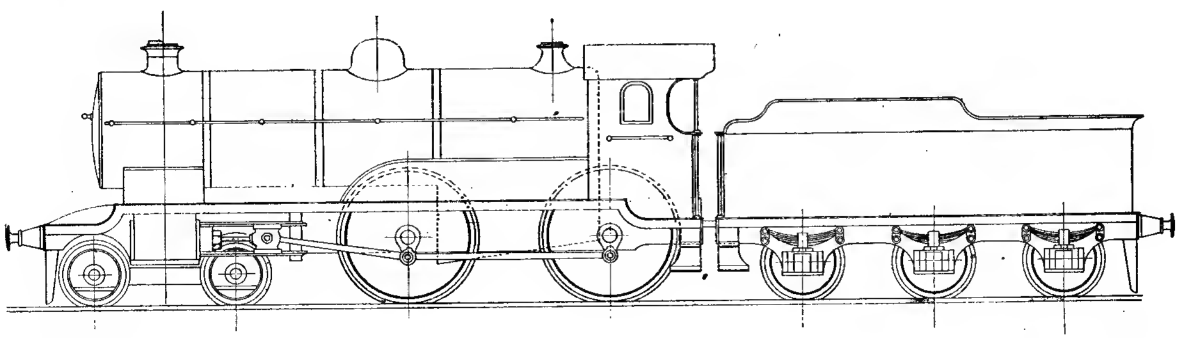
If a micrometer is available, measure the width of the parting tool, add the 0.187 in. to this. Set the topslide reading to zero, move the saddle along until the parting tool just touches the face of the bar, and clamp the saddle.

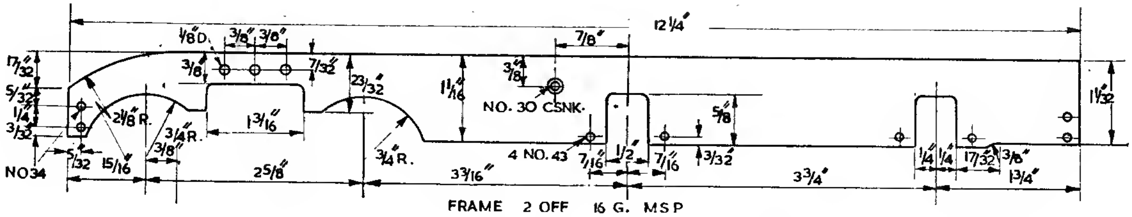
Now move the topslide by 0.187 in. plus the width of your tool, and the tool will be set exactly right for the parting operation. Repeat the process for each axlebox.

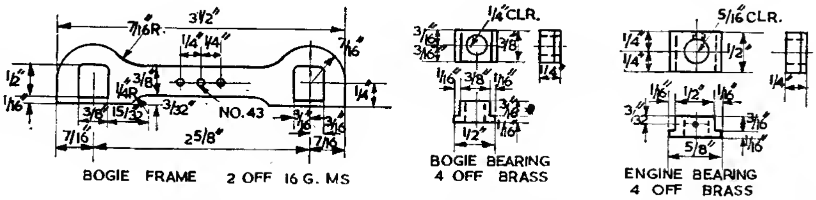
Lay the four boxes on your strip



Front and side elevations of the ME gauge 1 steam locomotive







Details of the frames and axleboxes. The hole for the spring pin is tapped 8 BA on the underside of the axlebox

of $\frac{1}{16}$ in. brass, which should be previously tinned, with about $\frac{1}{4}$ in. between each box, then solder up. Saw off each box, leaving sufficient to form the flange, and finish off with the file.

The flanges should be finally secured by drilling and tapping 10 BA halfway through (from the flanged side) and screwing in tightly a couple of brass screws, any type of head, cutting off the excess and cleaning up flush.

Now drill right through the axlebox, using the same drill as before, finally opening out to $\frac{5}{16}$ in. Drill No 50 and tap 8 BA for the spring pin, and run your drill (or reamer) through once again to remove burrs.

The springpins are $\frac{7}{8}$ in. lengths of 3/32 in. dia. silver steel, turned down at one end to 0.089 in. dia. × 3/32 in. long, and threaded 8 BA. The other end being directly threaded 7 BA for a length of 9/32 in. Screw the springpins tightly home into the axleboxes —if they should protrude slightly into the bore, they can be trimmed off flush with a needle file.

The springs are wound with 0.019 in. piano wire, a mandrel of 3/32 in. dia. silver steel being used in the lathe for this purpose. When not under compression the springs should measure about $\frac{11}{16}$ in. long.

WHEELS

Having tried several different ways of machining wheels, I am inclined to think that our friend LBSC's usual method is as good as any, so kick off by chucking each wheel casting in the three-jaw, back outwards, and face right across with a round-nose tool set crosswise in the toolholder.

Check the thickness of the casting at this stage, with calipers or rule, as it is advisable not to leave too much metal to be turned off the front or the spokes will come out too close to the rim.

Centre, drill and ream $\frac{1}{4}$ in. dia. for the drivers, and $\frac{3}{16}$ in. for bogie and tender; if no reamers are available, use a letter **D** drill immediately before the $\frac{1}{4}$ in. drill, and No 13 before the $\frac{3}{16}$ in. drill. Lightly countersink the axle holes at the back of wheel.

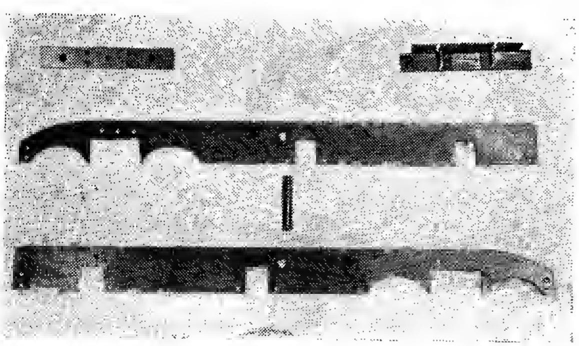
Complete this first operation on all wheels before starting the second.

For turning the tread, flange and rim, a suitable casting is used, such as a disc wheel, small chuck backplate or even a large cylinder cover. For the drivers, the outside diameter of this casting (after machining) would be about $2\frac{7}{16}$ in., and $1\frac{5}{16}$ in. dia. for the tender wheels. The same casting can be used for the bogie wheels by turning another $\frac{1}{8}$ in. or so off the outside.

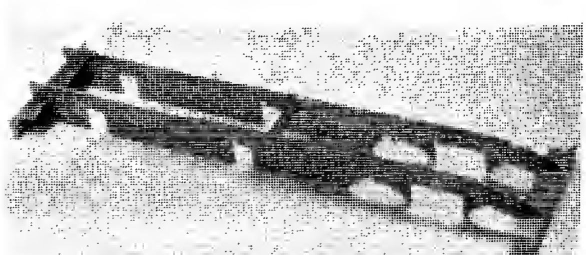
Rough turn the casting all over, in the three-jaw, and for the driving wheels, centre, drill, and force in a short length of $\frac{5}{16}$ in. dia. ($\frac{1}{4}$ in. for bogie and tender) b.m.s. rod. Turn this down until the wheels are a nice sliding fit on it, without shake, and thread the end $\frac{1}{4}$ in. BSF (bogie and tender 2 BA). The drivers can now be mounted in turn, face outwards, and held tight against the casting by a nut and washer.

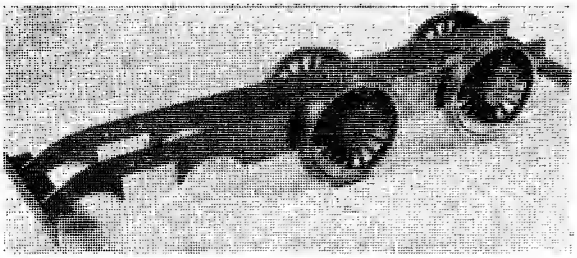
Incidentally, it is a good plan to slightly relieve the face of the "backplate" for the inner 1 in. dia. or so, in order that the wheel may bear only by its outer diameter, and not by its boss. However, should the wheels tend to slip under the pressure of the turning tool, this is easily cured by fitting a small screw to the "backplate" coming through the spokes of the wheel.

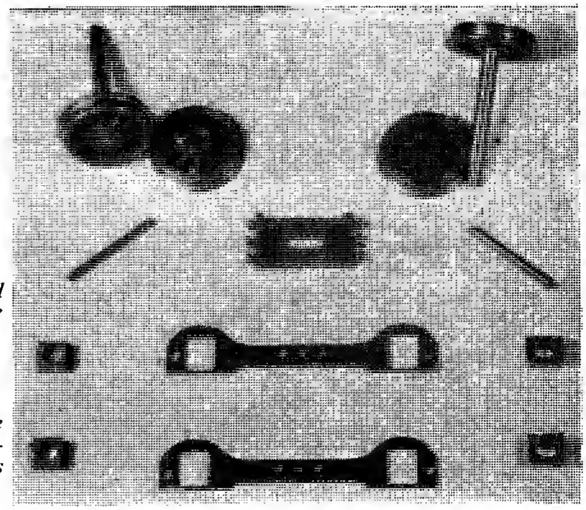
The rim and balance weight may be machined with the tool set roughly at



Left: Mainframes, buffer beams and stretcher
Below: The mainframes assembled







Above: *Wheels and axles fitted to the mainframes*

Right: *The bogie parts—frames, axle-boxes, axles, wheels and stretchers*

45 deg. to the wheel, and by noting the setting of the topslide (the saddle being locked to the bed) all wheels will come out exactly the same thickness.

To turn the flange and tread, set the tool so that its left-hand side is at a small angle (say 10 deg.) to the wheel and the correct contour of flange will then be produced. The radius between the flange and tread will be determined, of course, by the radius of the tip of the tool, a suitable radius for gauge 1 wheels being about 1/32 in.

By noting the readings of the top-slide and cross slide (or by the position of the handwheels) all wheels should come out identical. Round off the flanges with a file (*with* handle on !)

The final operation—to machine the boss of the wheel—can be done by chucking the wheel directly in the three-jaw. Don't chuck too tightly or the flanges will be marked. Free the saddle, bring up the tool until it just touches the rim of the wheel, clamp the saddle again, then bring the topslide back 0.062 in. and the setting will give the correct thickness for all the wheels.

The next job is to drill the driving wheels for the crankpins. Make a simple drill jig out of a short length of b.m.s. bar, about $\frac{1}{2}$ in. × $\frac{1}{4}$ in. section, drill two holes No 34 to start with, exactly 13/32 in. apart, open one hole out to No 32 and the other to a press fit for $\frac{1}{4}$ in. (letter D drill) and countersink both holes (60 deg. countersink if available).

A short piece of $\frac{1}{4}$ in. dia. silver steel is pressed into the jig, standing out a distance of about 9/32 in. The jig can now be clamped to each driving wheel in turn, being lined up with the crank, and the No 32 drill run through both jig and wheel. Remove the jig and follow up with a No 31 drill, when the wheels will be ready for the crankpins.

AXLES

The axles are turned from $\frac{5}{16}$ in. dia. round ground mild steel ($\frac{1}{4}$ in. dia. for bogie and tender), being held in a collet if available. If the three-jaw chuck is used, check for truth before commencing turning and, if necessary, pack out with a strip of brown paper until the bar runs true.

I prefer to turn both ends of each axle in turn, to bring them to the correct overall length first. It is then an easy matter to use the topslide to obtain the exact length of wheel-seat. It is also not a bad plan to set the topslide to turn very slightly taper (not more than $\frac{1}{2}$ deg.). Start by turning the wheel-seats to 0.002 in. oversize, measured in the middle of same, then try a wheel on, and take a further very fine cut, if necessary.

It should be possible to push the wheel on by hand about halfway if the turning is correct.

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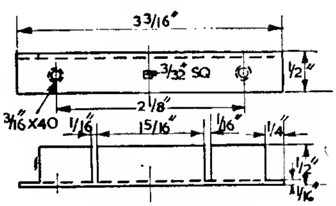
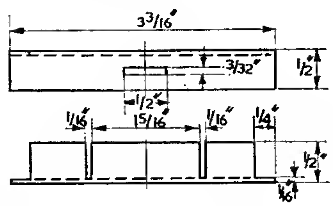
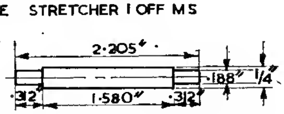


FRONT BUFFER BEAM 1 OFF BRASS

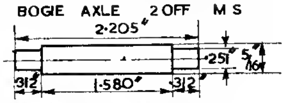


DRAG BEAM 1 OFF BRASS

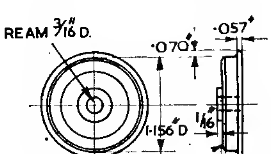
FRAME STRETCHER 1 OFF MS



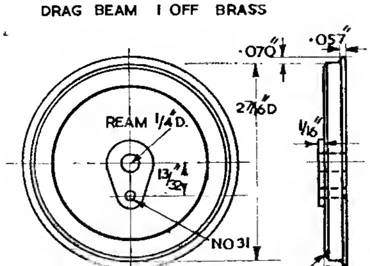
BOGIE AXLE 2 OFF MS



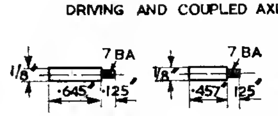
DRIVING AND COUPLED AXLE MS



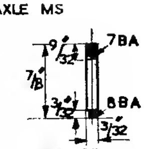
BOGIE WHEEL 4 OFF



DRIVING AND COUPLED WHEEL 4 OFF



CRANKPIN SILVER ST.



SPRING PIN 4 OFF SILVER ST

ON JUDGING

SIR,—Mr Higgs' reasoning [Postbag, August 29] on the relative merits of true scale and freelance models seems to me to be a classic example of drawing completely false deductions from untenable premises.

On the North London Model Association's stand at the ME Exhibition was Mr Tucker's freelance Garratt locomotive, a past Championship Cup winner. Can Mr Higgs really delude himself that there is anything whatever about this truly magnificent piece of work that shows evidence of Mr Tucker's "limitations as a craftsman"?

Some of the finest examples of craftsmanship ever shown at past ME Exhibitions have been freelance designs. As instances which spring instantly to mind are: Commander Barker's first three marine engines—the side lever paddle engine, the horizontal screw engine and the oscillating paddle engine; Mr Cecil Fox's 4-6-4 tank locomotive (illustrated on the cover of your issue for May 20 and a runner-up to Mr Tucker's Garratt); Willoughby Bros' *Peter*. These are outstanding examples of craftsmanship and design.

In my experience equipment limitations have little or nothing to do with the quality of the end product. While comprehensive equipment is of great assistance to rapid working, its absence rarely, if ever, handicaps the true model engineer in turning out first class work.

One would naturally assume that "ability to design" is to the credit of its possessor and as such should be entitled to a higher award than can be attained by the copyist.

For years now the tendency in this country has been more and more for people to get their thinking done for them, a tendency that has been quite noticeable in the model engineering world.

Obviously it is not given to all, or even the majority of, model engineers, to evolve their own designs, but the man who has the ability to evolve an efficient design and to bring it to fruition is a more accomplished all-rounder than is the copyist, and as such is fully entitled to additional award for his additional ability.

The suggestion that the freelance designer produces his designs "... to obviate the problems which the prototype modeller must face when faithfully reproducing in miniature all the known details despite the limitations listed" (what limitations and where listed?) "and especially in the case of working models" strikes me as being a piece of verbose and unrealistic jargon, quite at variance with easily ascertainable fact.

Nobody suggests that the judging system is perfect, much less that mistakes are never made under it, but over the years in the hands of competent judges it has amply demonstrated its essential soundness and nobody, so far, has produced a better one.

The only facet of model engineering which can definitely claim to have influenced full-size practice is model yacht building, which has always been notable for freelance designing as opposed to copying full-size prototypes. There is far too little original thinking among the majority of model engineers, and every endeavour should be made to encourage such thinking and to offer incentives for it.

Rustington, Sussex. K. N. HARRIS.

GAS ENGINE ...

Continued from page 570

quite well and enables a sound joint to be made. Alternative materials for the needle are phosphor bronze or German silver—not ordinary brass.

A check spring should be attached to the carburettor body to prevent inadvertent movement of the needle control when once set. This may be held in place by a screw tapped into the body (see general arrangement drawing) or shaped so that it can be clamped under the shoulder of the needle guide.

If it is desired to provide for priming the carburettor for starting from cold a hole may be drilled in the throttle cover, and a little shutter plate (secured by a screw or rivet) may be arranged to slide over and close it to prevent air leaks when not in use.

● *To be continued*

NEWBURY ...

continued from page 567

In the case of the tender axles, the journals should be brought down to 5/32 in. dia. and lightly polished after turning. The tender wheels may be pressed home on their axles at this stage, using the lathe to ensure their going on true.

The locomotive axles may with advantage have small centre holes drilled in their ends, this being done while still in the three-jaw.

BOGIE

The bogie sideframes are cut from $\frac{3}{4}$ in. × $\frac{1}{16}$ in. flat bright mild steel. They are held at the correct distance apart by a central stretcher, which may be a casting or bent up from $\frac{1}{16}$ in. b.m.s. plate, and by two $\frac{1}{8}$ in. dia. round stretchers which are held in place by 10 BA countersunk steel screws.

The axleboxes are exactly similar to the main boxes except that $\frac{3}{8}$ in. square brass bar is used instead of $\frac{1}{2}$ in., and no spring pins are used. The springing consists of three strips of 0.015 in. hard phosphor-bronze on each side, held in place by one 8 BA screw; the ends of the longest (and lowest) strip should be bent downwards slightly so as to engage exactly in the middle of the axleboxes.

The bogie centre pin, turned from b.m.s., is threaded 6 BA for screwing into the middle of the cylinder casting.

Crankpins are turned from $\frac{1}{8}$ in. dia. silver-steel rod held in the three-jaw, the thread for retaining nuts being made 7 BA. It is advisable to ease the ends of the crankpins slightly where they enter the wheel, otherwise there is always the danger of cracking the wheel bosses when pressing the pins home.

Put a nut on the crankpins before pressing in, to protect the thread.

COUPLING RODS

These are cut from $\frac{3}{8}$ in. × $\frac{1}{8}$ in. b.m.s. I cut mine entirely by hand, though anyone fortunate enough to possess a horizontal milling machine will make short work of them, clamping them together in the machine vice and using a small diameter cutter. However, the important thing is to get the rods the right length!

My usual way is to use a large pair of dividers and set these, not from the axle centres, but from the edge of the axle (it is easier to see when you are "spot on" this way).

Having marked out one rod, the holes are drilled $\frac{1}{8}$ in. and the second rod clamped to the first with 5 BA screws.

If hand filing, it is easiest to file the top and bottom edges first, then shape the bosses and oilboxes, either by filing, or by swinging the rods individually about a $\frac{1}{8}$ in. dia. peg on the end of a piece of square steel and feeding into an end mill in the chuck.

My intention is to use the coupling rods for quartering the wheels, but those who prefer to use other methods of quartering can open out the holes with a No 29 drill ready for case-hardening.

Don't case-harden until the wheels and axles are assembled and running freely—just in case!

● *To be continued*

A 4-4-0 TENDER ENGINE FOR BEGINNERS

The ME gauge 1 steam locomotive

By MARTIN EVANS

Care with the cylinders is especially emphasised in this second article on the construction of a spirit-fired locomotive

In my first article I dealt with the mainframes, axleboxes, wheels and axles, and the bogie.

Coming now to the cylinders, which are, one may say, the "heart" of the model, it must be remembered that in gauge 1 you have no big reserve of steam to play with, as in a $3\frac{1}{2}$ in. or 5 in. gauge model. So care must be taken to see that no steam is wasted. Certain it is that extra trouble taken at this stage will be amply repayed later on.

There are half a dozen different ways of tackling the cylinders, so take your choice! My method was to hold the cylinder block in the 4-jaw and take a cut right across each end to bring it to correct length.

If you adopt this method, it is most important to ensure that the block is held true in the chuck. This can be checked by applying a medium to large square to the edge of the block and "sighting" the blade against the lathe bed, or—and this is a more accurate way—traverse the cross slide right across the face of the block and check with a feeler gauge. When you have one end machined this end can be held firmly against the chuck body while tightening up.

Another method for machining the ends is to clamp the block on a vertical slide mounted on the lathe boring table and traverse the whole thing across a large end mill held in the chuck. This is a good way, for after the second face has been machined, you are all set to begin drilling out the bores.

Start the bores with a centre drill and open out gradually to 27/64 in., reducing the mandrel speed as you go up with the drills.

A $\frac{7}{16}$ in. parallel reamer could now be used to finish the bores, but it is really asking rather a lot to expect the reamer to remove 1/64 in. A better way would be to follow the 27/64 in. drill with a small boring tool which may be held in the 4-jaw. This can be used to bring the bore up to about 0.005 in. under the $\frac{7}{16}$ in.

If anyone is fortunate enough to possess an expanding reamer with a range about 27/64 in. to 29/64 in., drill the bores out to the full $\frac{7}{16}$ in. dia. and put the reamer through by hand *afterwards*; the reamer should be set to remove about 0.003 in. I employed this method myself, and the result was quite satisfactory.

There is another method of holding the block for drilling the bores. On the ML7 lathe it will be found that the block can be clamped (by each cylinder flange in turn) under the toolholder, the other end being swung round and bedded against the nearest T-slot in the cross slide.

The cylinder has to be packed up to bring it to lathe centre height and must be adjusted most carefully to ensure that all the faces are square. If this is not done there will be plenty of trouble later on when the covers are fitted!

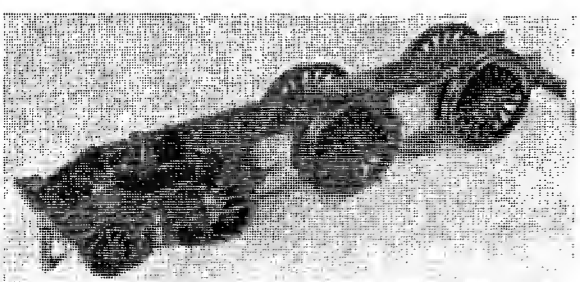
The next operation is to drill and tap the exhaust pipe. This can be done by holding the block in the 4-jaw again and drilling and tapping from the tailstock in the usual manner.

The cylinder block held in the 4-jaw for facing the ends

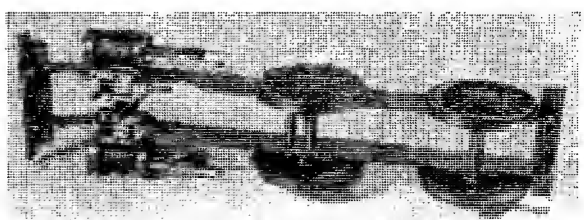
Use 5/32 in. drill and tap $\frac{3}{16}$ in. × 40 T. Be careful not to go down too far with your drill or you will break into the live-steam passageway—which can now be drilled and tapped $\frac{1}{4}$ in. × 40 T right through.

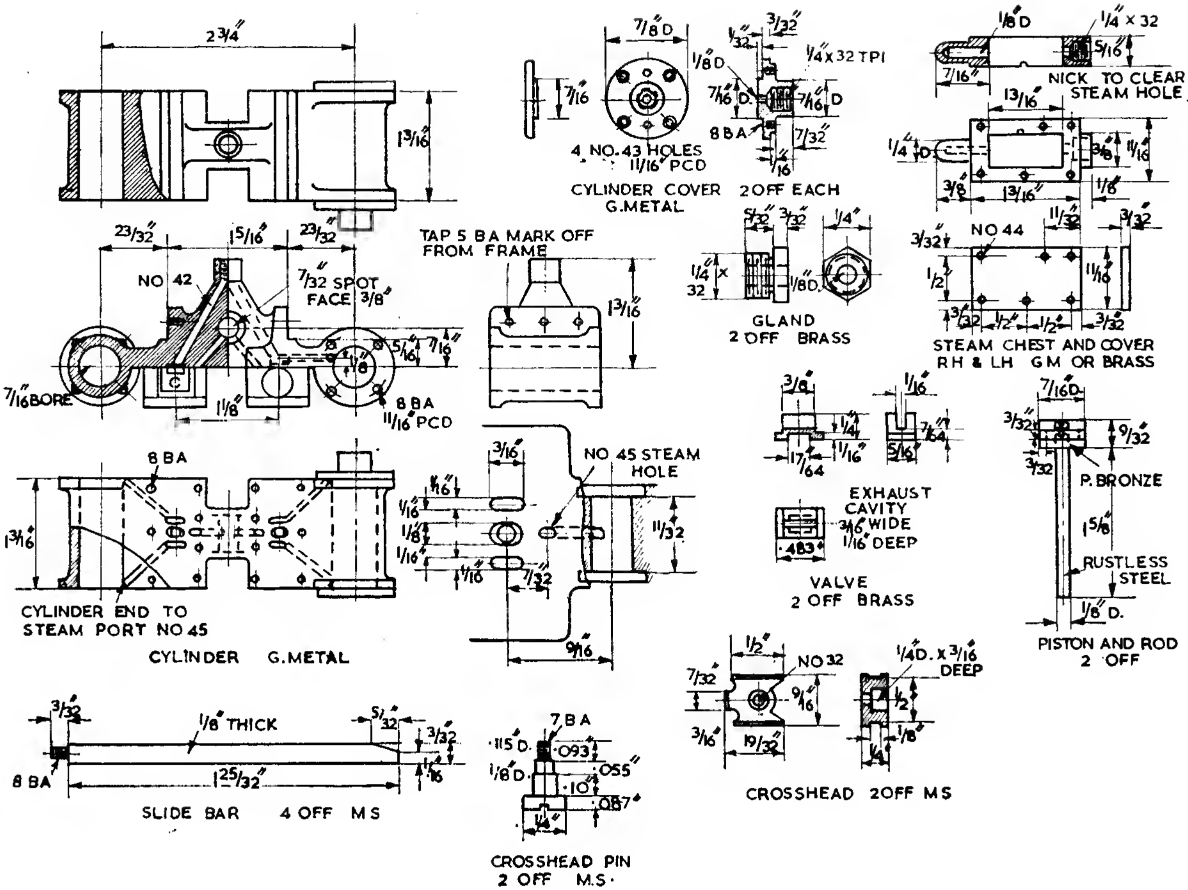
The bolting flanges look a bit tricky to machine; unfortunately they are not easy to file as the cylinder flanges get in one's way.

But again milling machine owners are in clover! Simply put two side and face cutters on your arbor, any diameter between $1\frac{1}{2}$ in. and 3 in. and thickness around $\frac{1}{8}$ in. to $\frac{1}{4}$ in.,



Left: Chassis, with the cylinders and slide bars fitted
Below: The underside of the chassis





and set them exactly $1\frac{5}{16}$ in. apart—and away you go. Slotting cutters could also be used.

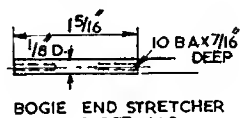
Modellers with lathes only should set the block up on the vertical slide clamped to boring table. The block may be clamped direct with the cylinder flanges bearing against the vertical slide, but if doing this check that the block is square in all directions.

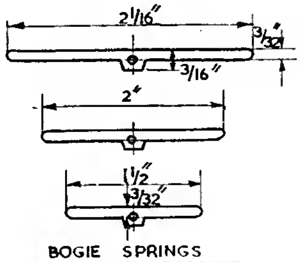
An end mill $\frac{1}{8}$ in. to $\frac{1}{4}$ in. dia. held in the 3-jaw or collet may be used, the block being fed up or down according to the direction of cut.

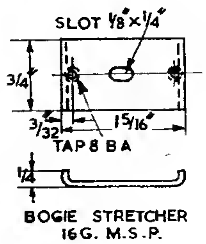
The cylinder block can now be temporarily fitted to the frames, these being held in position with toolmaker's clamps, while a $\frac{1}{8}$ in. drill is run through the holes in the frames and countersinks made on the cylinder bolting flanges. These are then drilled No 39 and tapped 5 BA.

STEAM AND EXHAUST PORTS

The next job—machining the port face—is, again, very easy on a milling machine, one fair-sized side and face cutter being required. Lathe users will probably clamp the block on the vertical slide once more, though this time packing blocks will be needed







under the cylinder flanges so that the exhaust pipe clears the face of the slide. Almost any size end mill can be used here.

The steam and exhaust ports could be cut with a dental burr, but as this tool needs a higher speed than most lathes are capable of, I strongly recommend a slot drill. LBSC has described how to make these; they can also be purchased ready-made in high-speed steel, down to $\frac{1}{16}$ in. dia. I used one of the latter and found it excellent for the job. It was run at 500 r.p.m., which speed seemed about right for gunmetal.

The set-up for machining the port face may be used again for cutting the ports. Mark out one steam port (say the front one) for each cylinder, cut this first, using the dials on the vertical slide and cross-slide handles to ensure the correct size of port. It is then a simple matter to move the vertical slide to obtain the right size and spacing for the exhaust port and the other steam port.

If you are fortunate enough to have a graduated hand wheel on your leadscrew (as on Super 7 lathes, etc.) use this for gauging the depth of the ports, but *don't hurry*! It doesn't take much to break a $\frac{1}{16}$ in. dia. cutter.

4-4-0 TENDER ENGINE . . .

continued

The steam and exhaust passages are next drilled, the block being set up on the drilling machine table at the required angle, and the drill " sighted " so that it will come through at the correct point. It will be found easier to file a small flat at each cylinder end to take a centre pop, following up with the drill in the usual manner.

Before attempting to drill the exhaust passage, centre pop the port deeply *slightly nearer the centre of the block than the exact centre of the port.* This is because the drill tends to " lean over " towards the outer edge of the port, due to the angle the drill makes with the port face—and there is always the danger of the side of the drill catching the edge of the port.

SLIDE VALVES

I made my slide valves from hard brass bar 5/16 in. square, and the whole of the machining was done by a slot drill and an end mill, held in the 3-jaw. The best way is to bolt a small machine vice to your vertical slide, with the jaws horizontal, and clamp the bar in this. Mill out the recess first, using the 1/16 in. dia. slot-drill again, checking the vertical-slide dial and cross-slide dial to ensure correct dimensions; the ends can then be machined with an end mill about ¼ in. dia. by setting the bar to overhang the machine vice at one end.

The slot across the top of the valves could be cut with a slitting saw, although the 1/16 in. slot drill could be used again. But in this case remove some of the metal first with a hacksaw.

STEAM CHESTS

The steam chests can be milled, machined in the 4-jaw or even filed. The bosses can be turned at the same setting, though it is important to get the casting running quite true in the chuck.

After drilling the gland boss, run the drill right through and make a small centre pop on the far side of the steam chest, remove the steam chest from the chuck and check the position of this centre. If it should be out, it can easily be corrected by means of a centre punch. Drill this second hole undersize to start with, and check once again before opening out to final size (⅛ in.).

The gland boss can then be opened out to 7/32 in. dia. and tapped ¼ in. × 40 t or 32 t.

The valve rods are made from ⅛ in. rustless steel, the flats to fit the slot in the valve being hand filed, and the rear end threaded 5 BA—or, better still, ⅛ in. × 60 t. A very small flat should be filed on the front end of the valve rods (the part which works in the front bar of the steam chest) in order to prevent any possibility of water being trapped at the end of the hole.

CYLINDER COVERS

The cylinder covers are chucked in the 3-jaw and the inside face machined to a close fit in the bores. In the case of the rear covers these should be centred and drilled (⅛ in.) at the same setting. To machine the other side, the covers should be held in a split ring in the chuck; the gland boss can then be opened out and tapped ¼ in. × 40 t or 32 t. A pilot tap with ⅛ in. dia. pilot is very useful here, to ensure truth.

The fixing holes may be set out on one cover and this used as a jig for drilling the cylinder block. Use a No 50 drill, tap the holes in the cylinder 8 BA, then open out the cover holes with a No 43 drill. Eight BA hexagon-head screws, 3/16 in. long, are used, four being required for each cover.

The 8 BA tapped holes for the slide bars are spaced 19/32 in. apart, and as it is very important to get these at exactly the same distance from the piston centre line, it is worth temporarily plugging the hole in the gland boss to take the divider point (the plug, of course, having a fine centre put in with the lathe). Alternatively, a little drilling jig could be made up, with a ⅛ in. dia. pin to register in the piston rod hole. This would then be swung round to drill each hole in turn.

PISTONS

A short length of ½ in. dia. drawn phosphor-bronze bar is used for the pistons. Rough turn the pistons to slightly over 7/16 in. dia., centre and drill through with a No 40 drill, then chuck separately, open out with No 31 drill for half the length of the piston and tap the remainder 5 BA. The piston rods, of ⅛ in. dia. rustless steel, can then be screwed tightly in by holding them in the tailstock chuck and pulling the lathe belt by hand.

If you have one, a collet is ideal for the final finishing of the pistons. Alternatively, make up a split bush held in the 3-jaw. Personally, I don't usually bother about either, and use the 3-jaw direct but with the jaws packed out with a strip of brown paper, using a dial gauge direct on the piston rod to ensure true running. The packing groove can be turned with a small parting tool.

SLIDE BARS

The slide bars are filed down from ⅛ in. square bright mild steel or silver steel as preferred; the ends are threaded 8 BA, the 4-jaw chuck being used to hold them for turning and threading the ends.

CROSSHEADS

Bright mild steel 9/16 in. × ¼ in. section is required for the crossheads, so mill or saw and file up enough for the two crossheads from the nearest section available (probably ¾ in. × ¼ in.).

Chuck the bar in the 4-jaw and set to run true, then turn the boss but do not drill it for piston rod at this stage. Incidentally, a small boring tool may be found useful for " cutting-in " between the boss and the body of the crosshead, the boring tool being set straight in the toolholder instead of the usual crosswise position used for boring. Then reverse the bar and turn the other end as before.

The next operation is to mill the grooves for the slide bars. If a regular milling machine is not available, this can be done in the lathe very easily by clamping the bar in a machine vice bolted to the vertical slide and traversing across a ⅛ in. end mill or slot drill held in the collet or 3-jaw. By engaging the leadscrew and turning same by handwheel, the exact depth of cut can be regulated. The crossheads can then be drilled and opened out for the little-end with a pin drill.

To drill the crosshead boss, put the crosshead between the slide bars (with the rear cover removed from cylinder), run it hard up against the gland and clamp it there; a ⅛ in. drill can now be run through from the back and a countersink made on the boss. Remove, drill No 31 and ream out with a ⅛ in. reamer until the piston rod is a nice push fit in the boss. Make a small countersink in the outside of the boss ready for drilling.

The crosshead pins are straightforward, being turned from ¼ in. dia. silver steel. Use 7 BA nuts on the outside faces to lock them in position.

Amendments to drawings

Cylinder covers: pitch of 8 BA tapped holes should be shown as 19/32 in. apart. Steam chest and cover: holes shown No 44, should be No 43. Bogie springs: quantity each should read " *2 off* "; material should read " P. Bronze 0.016 in." Bogie stretcher: slot should be ⅛ in. × ⅜ in.

● *To be continued*

NEWBURY—A 4-4-0 TENDER ENGINE FOR BEGINNERS

The ME gauge 1 steam locomotive

This week MARTIN EVANS discusses the connecting-rods and motion brackets

(Continued from 7 November 1957, pages 629 to 631)

HAVING dealt with the cylinders, slide bars and crossheads, I come now to the connecting-rods.

These can be cut from 3/8 in. × 1/8 in. bright mild steel. It is hardly worth while milling these as they can be sawn and filed up quite quickly. Mark out the outline of the rods and start by drilling the holes, which can be made finished size.

If anyone prefers the rods to be fluted, this may be done by bolting a length of heavy steel angle to the vertical slide (a piece 8 in. long × 1½ in. × 1½ in. × 3/16 in. does very nicely) and setting the angle cross-wise in the lathe, i.e. with the table of the vertical slide facing the lathe mandrel.

The connecting-rod blanks may then be laid on the horizontal side of this angle and held down by 5 BA screws. To obtain a properly tapered flute, the little-end can be held down by one screw but the big-end should be clamped down by a short piece of flat steel about 3/8 in. × 1/8 in. section, two screws being used, through clearing holes in the strip into tapped holes in the angle. The big-end may then be swung round to give the required taper.

A suitable cutter, which could be held in a collet or in the three-jaw, would be one 1 in. to 1½ in. dia. and 1/16 in. to 5/64 in. wide. If anyone has a Woodruffe cutter of this width, this would be ideal as the diameter is small.

The outside of the rods can then be completed as described for the coupling rods and the ends case-hardened.

The motion brackets consist of a piece of 1/16 in. brass or steel sheet, sawn and filed to shape and attached to the frames by 1/4 in. × 1/4 in. × 1/16 in. brass angle. Be careful to get the slots for the slide bars exactly in line and the correct distance from the frames. (The latter can best be checked by applying a pair of inside callipers between the front end of the slide bar and the frame.)

The cylinders may now be packed, using oiled paper between the block, steam chest and covers, and graphited yarn in the pistons and glands.

ECCENTRICS AND STOP COLLARS

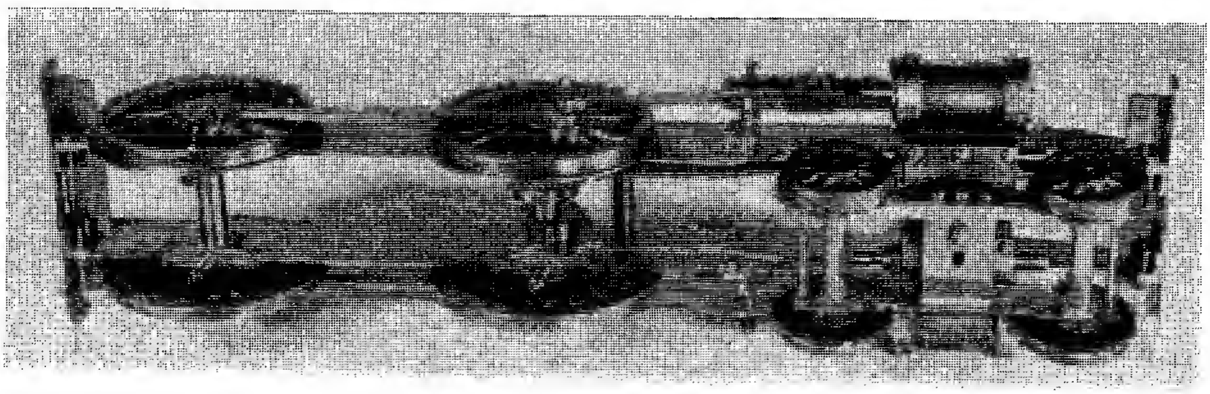
The eccentric sheaves are turned from 3/4 in. dia. mild steel. Turn the outside and face one end, then remove from the three-jaw and mark the centres for the axle hole and the stop pin. Now mount in the four-jaw chuck and set to run true about the centre for the axle hole; drill and ream 5/16 in. from the tailstock.

Part off and repeat for the second sheave. Drill No 31 for the stop pin, ease the hole slightly with a 1/8 in. dia. parallel reamer and press in a length of 1/8 in. dia. silver steel.

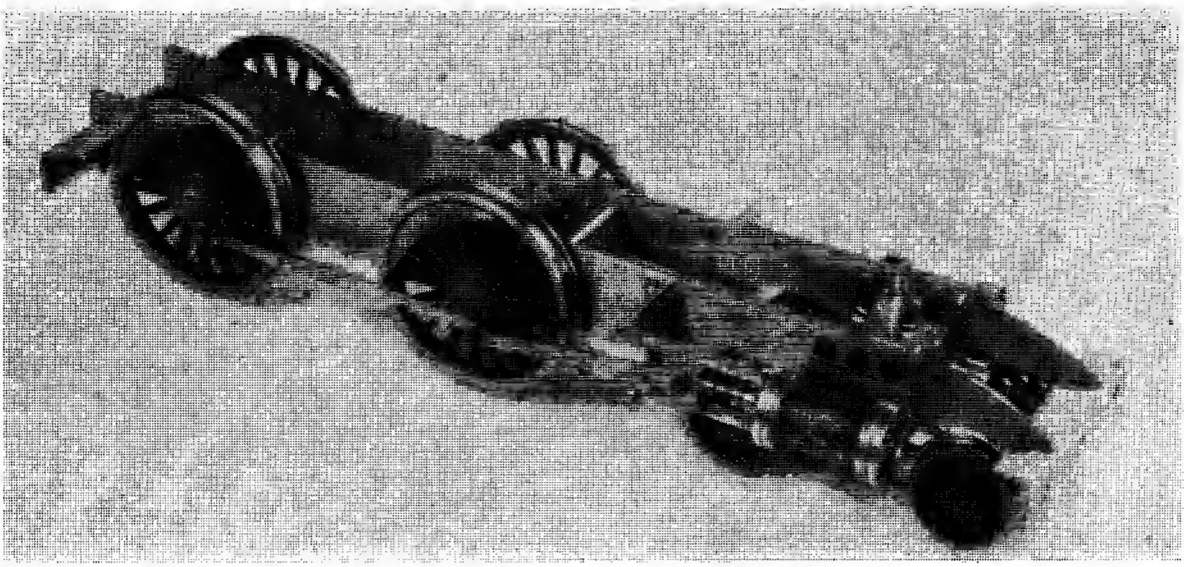
The stop collars are also turned from 3/4 in. dia. b.m.s., drilled and reamed 5/16 in. while still in the lathe, and the gap hand-filed. A hole is drilled and tapped 6 BA on the opposite side for a setscrew—a cheesehead screw of such a length that the head just clears the stop collar when right home.

Castings are used for the eccentric straps. Clean up the castings with a file, drill right through with a No 50 drill for the securing bolts, then saw in half. Tap the front halves 8 BA, open out the rear halves with a No 43 drill and clean up the "sawn" faces by rubbing them on a smooth flat file laid on the bench.

The two halves can now be numbered, screwed together, and the whole held in the four-jaw for boring and facing one side. They should not be made too close a fit on the sheaves as it is easier to tighten them up afterwards than it is to enlarge the bore. To face the other side they should be mounted on a stub of



The underside of the completed chassis



The chassis ready for the air test

b.m.s. rod held in the three-jaw (turned to a diameter slightly more than the sheaves themselves) and held by their own bolts.

The slot in the front of the straps for the eccentric rods could either be milled out with a $\frac{1}{16}$ in. thick slotting cutter (the strap being held in the lathe toolholder) or it could be sawn and filed.

The eccentric rods are cut from $\frac{5}{16}$ in. b.m.s. strip, the 3/32 in. dia. hole for the valve crosshead being case-hardened and the rod riveted to the strap with two $\frac{1}{16}$ in. dia. countersunk rivets.

VALVE CROSSHEADS

The valve crossheads are made from $\frac{3}{16}$ in. square b.m.s. Cross drill with a No 50 drill and slot for eccentric rods with a $\frac{1}{16}$ in. thick slotting cutter, then cut off and mount in the four-jaw for turning the boss and drilling and tapping 5 BA for the valve rods.

If anyone has $\frac{1}{8}$ in. × 60 t. taps and die, use these on the valve rods and crossheads rather than 5 BA. One side of the fork can now be opened out to 3/32 in. dia. and the other tapped 8 BA.

The valve gear can now be assembled; note that the eccentric sheaves go next to the axleboxes with the flanges on the outside, the stop-collars being set against them with just enough play to allow the eccentric straps to turn freely.

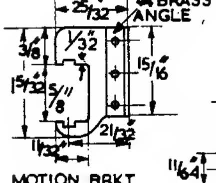
"QUARTERING" WHEELS

The driving and coupled wheels may now be "quartered." Push the second wheel on the driving axle and set it as near as you can by eye, the correct position being that the right-hand crank should lead the left-hand by 90 deg. Now press this wheel right home and push the second wheel on the coupled axle as far as it will go by hand—set this wheel as near as you can by eye.

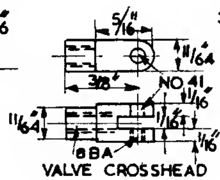
Next pack up the main axleboxes to running position by inserting a strip of metal between the bottom of the axlebox and the hornstay, and screwing up tight.

Slip on the coupling rods, which, if you have not opened out the holes, should be a close fit on the crankpins. By turning the wheels by hand, it will soon be apparent whether the wheels are set at the correct angle; if not, the wheel which is not yet pressed home can be turned one way or the other until the axles turn freely. It is simply a matter of trial and error.

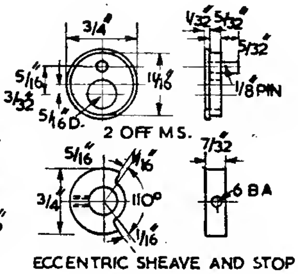
When you are satisfied that everything is satisfactory go ahead and



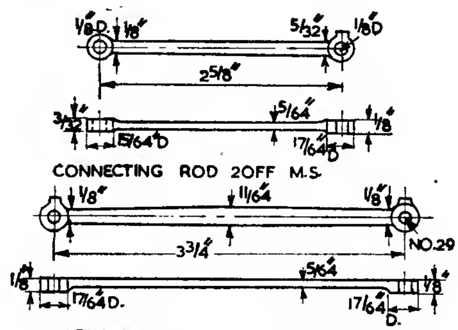
MOTION BRKT. 2 OFF 1/16 MS



VALVE CROSSHEAD 2 OFF MS



ECCENTRIC SHEAVE AND STOP



COUPLING ROD 2 OFF M.S.

4-4-0 TENDER ENGINE . . .

press the final wheel right home; the coupling rods can then be opened out with a No 29 drill, case-hardened, cleaned up and polished.

The next item is the pinning of the main crossheads to the piston rods, so push the piston hard up against the front cover and move the crank on that side of the locomotive to front dead centre.

Press the piston rod back 1/64 in. (i.e. further into the crosshead boss). If you have reamed the boss correctly, the piston rod will stay put for drilling, but if it doesn't seem too firm clamp it to make sure.

On my own job, I put a No 56 drill right through crosshead boss and piston rod, cut off part of the shank of a No 55 HSS drill, tapered this very slightly with a file in the lathe and pressed it home—leaving enough on the outside to grip by just in case it has to come out at any time.

VALVE SETTING

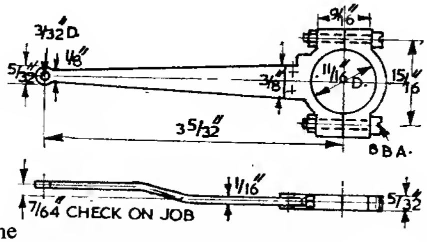
Remove the steam-chest covers, put a few nuts over the steam chests to hold them in position, turn the wheels by hand and watch the valves. Temporarily tighten the stop collars and check whether the valves uncover the ports an equal amount at each end. If they don't, the remedy is to turn the valve crosshead half a turn at a time, one way or the other, until the openings are equal.

To set the valves give the wheels a few turns in a forward direction and then stop them with the cranks at front dead centre. The valve should now just begin to open with the front port showing as a black line. If it fails to do so, turn the stop collar until it does.

Continue turning the wheels in the forward direction until the rear port cracks. If the crank is now at the rear dead centre, the setting is correct for forward gear.

However, if the crank is short of dead centre, the valve is too short and will have to be removed and a thin section of metal silver soldered on that side.

If the crank has gone past dead centre it means that the valve is too long and will have to be shortened. To do this remove an equal amount off *both* ends of the valve, so that the cavity remains in the middle. After replacing, the stop collar will have to



ECCENTRIC ROD AND STRAP
2 OFF MS & PB

be re-set in order to get the valve cracking each port at dead centres.

Now turn the wheels backwards and watch the valve again. If the ports crack at both dead centres, all is satisfactory. But if the ports crack before the crank reaches dead centre, a little will have to be taken off the shoulder of the stop collar.

If the ports do not crack until after the crank has passed dead centre, the shoulder of the stop collar will have to be made up by soldering or screwing a thin section of metal to the appropriate edge, or, of course, a new stop collar could be made. I hope neither will be necessary!

Well, that completes the cylinders and motion and you can now give them an air test. Don't forget, though, that the inner side of the main steam way will need a 1/4 in. × 40 t. plug fitting, the front side being used for attaching the lubricator and main steam pipe.

● *To be continued*

ZOE . . .

Continued from page 710

ashpan, as the pony truck comes very close to it, and would foul anything standing out when running over a line that was out of lateral alignment.

The British climate plays havoc with small railways just as it tries to do with their full-size relations, and as the small fry obviously don't get the same regular attention as the big ones, they are usually far from emulating the levelness of a billiard table.

I keep mine somewhere near the mark by putting then strips of wood between warped longitudinals and sleepers, as and where needed, but if I knew as much then as I do now I should have erected the line with light steel girders instead of wood longitudinals. Roy Donaldson should have no cross-winding trouble with his longitudinals made from scrap boiler tubes!

Don't erect the boiler permanently yet, as the pipework can be fitted and connected more easily while the boiler is still detachable. This is the next job.

● *To be continued*

ALLCHIN ME TRACTION ENGINE

Continued from page 701

The back and front covers, shown in Fig. 22, are identical except that the front one has the slot for the key. Cut these from 24-gauge brass, a little oversize, and drill the two No 65 holes at the sides in the back cover, and that corresponding to the key-hole.

Cut out the lock body (Fig. 23) from 16-gauge brass, and the lock bolt (Fig. 24) from 16-gauge bright mild steel. These will need some nice fitting to ensure that the one slides smoothly in the other. The 1/32 in. wide slot in the bolt is best cut with a slitting cutter in the lathe—doesn't matter if it has a square end instead of the round one shown. Do not open out the lower jaw of the bolt fully at this stage.

Clip the body and backplate together in correct relative positions, and jig-drill the No 65 holes through the body. Push two 21-gauge pins through both components to keep them correctly placed. Now with the bolt in the closed position, the location of the central pin can be marked off from the slot in the bolt, and drilled No 65. Jig-drill the front cover from the back one.

Making the lock work

Back cover and body may now be sweated together, with the three pins in place. Check the bolt in place to see that it slides nicely.

File up the key (Fig. 25) from a scrap of mild or rustless steel. Now the jaw of the bolt can be opened out gradually until the key will rotate properly, at the same time sliding the bolt back and forth.

The bolt will need to be eased in thickness, which can be done by rubbing both sides on emerycloth. With the front cover in place, it should move reasonably easily, but not too freely when the key is turned.

File up the hasp (Fig. 26) from rustless steel, and fit it properly Apply a spot of grease to the bolt—preferably graphited—and the front cover may be fitted, the pins being lightly riveted over.

In the concluding article of the Allchin ME model traction engine, which will appear shortly, the author will deal mainly with the technique of painting and lining out the finished engine.

THE BOILER FOR NEWBURY

By MARTIN EVANS

The construction of the inner boiler and boiler casing is dealt with in this, the fourth article on the 4-4-0 locomotive

(Continued from 21 November 1957, pages 702 to 704)

The ME gauge 1 steam locomotive

BEGINNING with the inner barrel, this consists of a length of $1\frac{3}{4}$ in. seamless copper tube 22 or 20 s.w.g. $6\frac{7}{8}$ in. long overall.

The first job is to square off the tube at both ends in the lathe, and it is advisable to plug the ends with wooden discs to avoid squeezing the thin tube in the chuck jaws, the outer disc having a good-size centre hole for support from the tailstock.

The holes in the top of the barrel for the safety valve and filler bushes are next drilled, and reamed $\frac{5}{16}$ in., and then the six holes of 5/32 in. dia. for the water tubes. The three front holes are " elongated " simply by inserting a piece of 5/32 in. steel rod and forcing down to the approximate angle required.

The bushes for the water filler and safety valves are turned from gunmetal or phosphor bronze and it is advisable to make these a light press fit in the barrel in case they should come loose while being silver soldered.

Now we come to the warm part of the job ! A blowlamp of one pint capacity or a small gas blowpipe will supply the heat comfortably. Use plenty of Boron compo or " Easyflo " flux around every joint and silver solder the lot at the one heat. As soon as you are satisfied that the silver solder has penetrated everywhere, remove the blowlamp, allow to cool to black and then place in your pickle bath. (This should contain dilute sulphuric acid, approximately one part of acid to 20 water.)

On my own boiler I tackled the front plate next. This was cut out from 16 s.w.g. copper sheet, well annealed, and flanged over a disc of $\frac{1}{4}$ in. thick mild steel of a diameter such that the flanged plate would not quite go into the barrel. After flanging, the plate was held in the three-jaw, with the jaws inside the flange, and the outside turned down to a tight fit in the barrel.

The two holes for main steam pipe and longitudinal stay can now be drilled 7/32 in. dia. and tapped $\frac{1}{4}$ in. $\times$ 40 t., and the plate pressed home into the barrel, to which it can now be silver soldered.

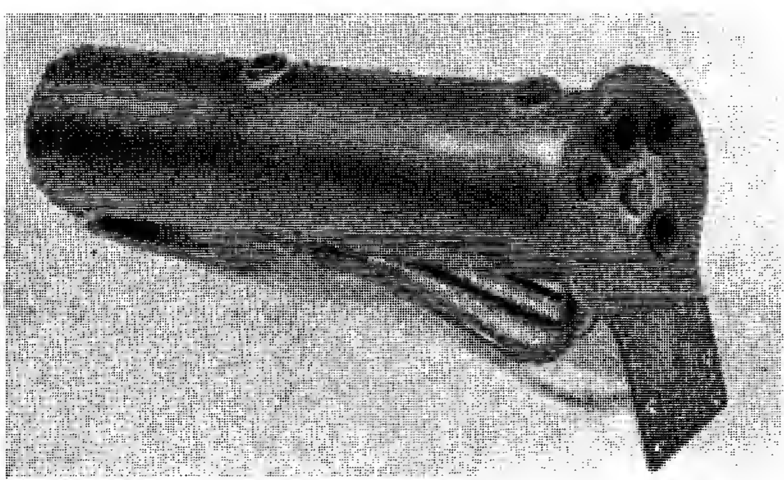
Most builders prefer to flange the backhead of this type of boiler and attach the outer casing by screws into this flange. However, this is not absolutely essential, and on my own boiler, I left the backhead flat and attached it to the outer casing by one screw into a little block fixed to the underside of the casing, at the extreme top corner, and by two screws into the closed-in portion of the wrapper (see drawings).

Having cut the backhead to shape, from 16 s.w.g. copper sheet, drilled all the holes, and pressed in the bushes, it was assembled in position and held in place by the centre stay and nipples. The silver soldering was then carried out, a generous fillet being run all round the join between barrel and backhead, and the bushes treated as before. The ends of the stay may also be run over with the silver solder, though soft solder could be used here if preferred.

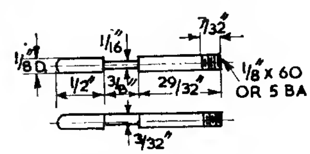
After each stage of silver soldering, the parts should, of course, be placed in the pickle bath and given a good clean up to remove scale and burnt flux, etc.

The completed inner boiler can now be tested. A water test up to 160 p.s.i. is required, followed by a test under steam to about 120 lb. All that is required is a large and reasonably accurate pressure gauge reading up to 250 p.s.i. or over, a tender hand pump, a tray or suitable vessel to hold water of about 1 in. depth, and threaded plugs to suit the various bushes.

Screw in the threaded plugs with a taste of white plumber's jointing compound, coupling up the hand pump to the check-valve bush, and mounting the pressure gauge on one of the bushes on top of the boiler. Now fill the boiler completely with



The inner boiler



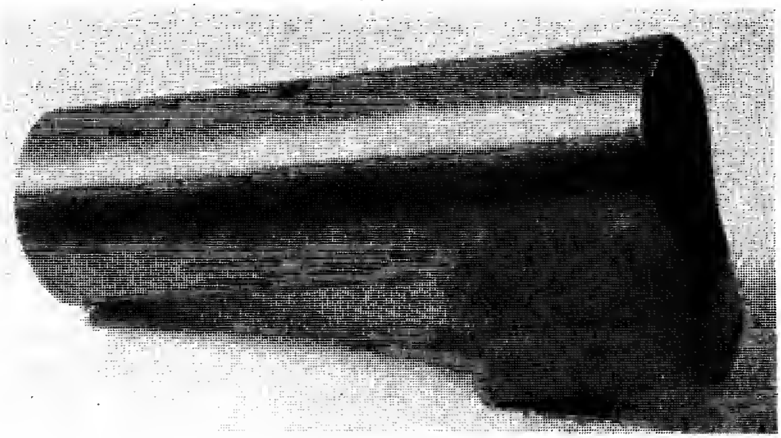
The valve spindle (see issue of November 7 for description)

water when a few strokes on the pump will bring the pressure up to the required figure.

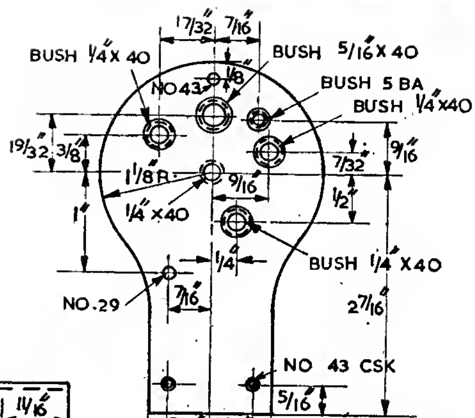
There is no danger of explosion with this water test, as water is, of course, practically incompressible and should a bulge occur, the pressure would drop immediately. If any slight leaks do show themselves, and no soft solder has been used in construction, it would be quite safe to reheat the offending spot, and re-silver solder. Use best-grade solder, plenty of flux, and scratch around the "leak" with a piece of iron wire while the solder is molten; this will ensure a sound joint when the heat is removed.

As a last resort, some Baker's fluid and a little soft solder could be put *inside* the boiler and the whole heated up to the melting point of the soft solder, a good shaking will then spread a thin coat all round the inside and should seal any slight leaks successfully. Wash out thoroughly afterwards.

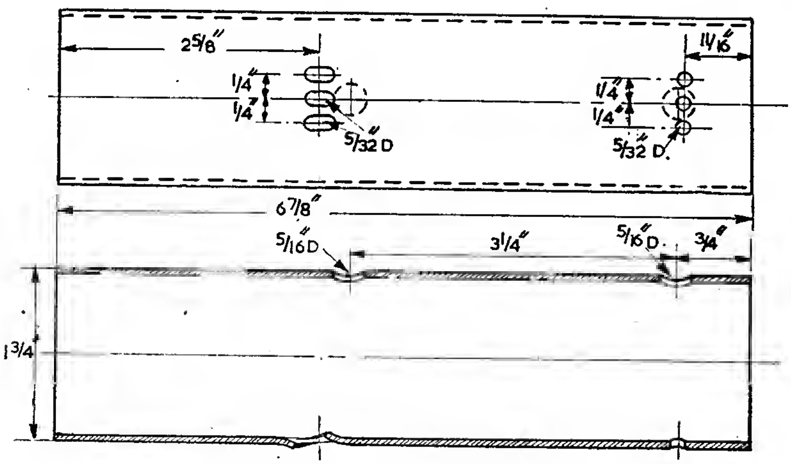
The steam test is almost the same as the water test, except that the pump is no longer required, so blank off the check-valve bush, and fill the boiler only two-thirds full. Now apply



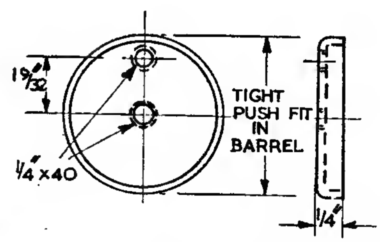
The outer boiler casing



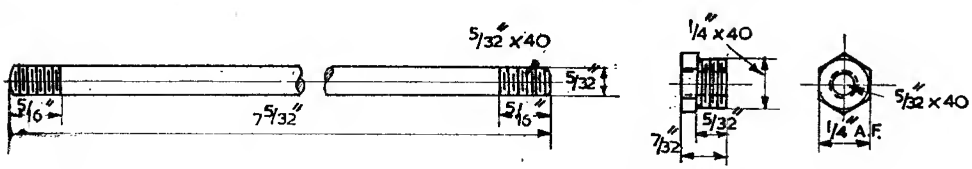
BOILER BACKHEAD
16 G. COPPER



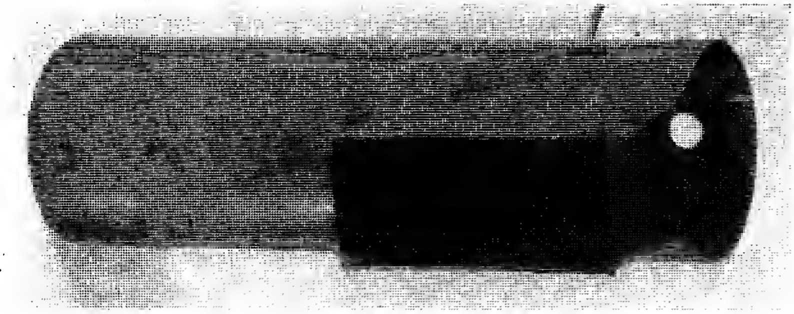
BOILER BARREL 20'G. SEAMLESS COPPER TUBE



SMOKEBOX TUBEPLATE
16 G. COPPER



LONGITUDINAL STAY & NIPPLE GUNMETAL OR P BRONZE



The outer boiler casing (underside)

sufficient heat around the water tubes (a Bunsen would do fine) to bring up to the boil and then steadily up to 120 p.s.i. The pressure should be held for a minute or two, when the source of heat can be removed; if all is well, that is one more hurdle successfully taken.

The next item is the outer casing. In my case I used $2\frac{1}{4}$ in. dia. brass tube, 20 s.w.g. thick. This is easier to work with but actually is not so efficient as steel here, as the latter does not conduct the heat away nearly so quickly and retains paint better; however, take your choice.

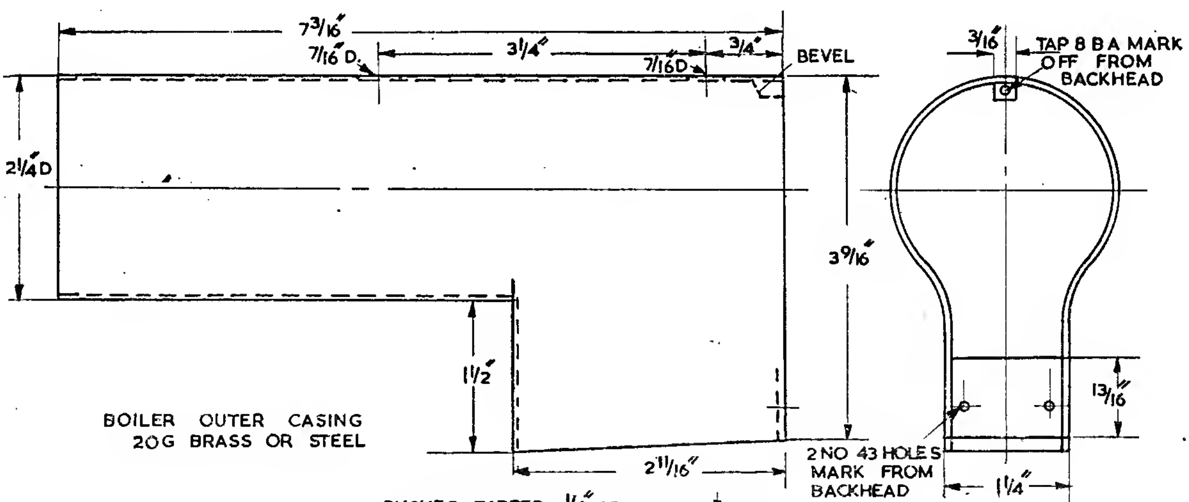
As with the inner barrel, the first job is to square off the ends in the lathe. The two holes, $\frac{7}{16}$ in. dia. to clear the filler and safety valve, can then be drilled, checking their spacing carefully from those on the barrel.

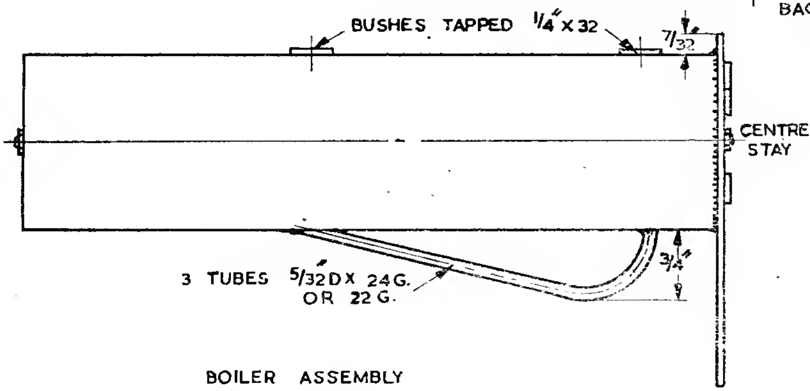
To form the firebox, a saw cut is made underneath the tube on the centre line $2\frac{11}{16}$ in. long, measuring from the rear edge. Another saw cut is then made, at right-angles to the first and to a depth of roughly $\frac{1}{4}$ the diameter of the tube, so that the rear end can be opened out to form the sides of the firebox. It is advisable to anneal before bending.

To obtain the depth of firebox required, two pieces of brass sheet, about 18 s.w.g., are required. One is used to form a miniature throat plate, to bring the depth of the firebox to $1\frac{1}{2}$ in. at the front end (measuring from the underside of the barrel). The second is bent up to a channel section, the base being $1\frac{1}{4}$ in. wide and the sides $2\frac{11}{16}$ in. Both are silver soldered in place, a few 8 or 10 BA brass screws being used to hold the parts in place, and afterwards filed flush.

The small block in the top rear corner of the casing, consisting of a piece of $\frac{3}{16}$ in. square brass bar about $\frac{3}{16}$ in. long, is temporarily held in place by a 10 BA brass screw and silver soldered. The inner edge of this block should be bevelled.

● *To be continued*





Details of the boiler outer casing and the three water tubes

THE SMOKEBOX FOR NEWBURY

THE ME GAUGE I STEAM LOCOMOTIVE

By MARTIN EVANS

(Continued from 5 December 1957, pages 774 to 776)

COMING now to the smokebox, the main item is the squaring off to length at each end, and this can be tackled exactly as for the boiler barrel. The front edge should be bevelled off slightly (this can be done with a file while still in the lathe), then the inside of the tube cleaned out for a ½ in. or so at each end with emerycloth.

The hole for the chimney liner is now drilled 7/16 in. dia. and that for the steam and exhaust pipes should be made an oval shape, though this is best checked off from the job itself.

A short length of thick-walled brass or steel tube is ideal for the "joint-ring," but if nothing else is available, a piece of brass strip about ¼ in. × ⅛ in. section could be bent around to form a circle and the joint silver soldered, finishing off by turning in the three-jaw in the usual way.

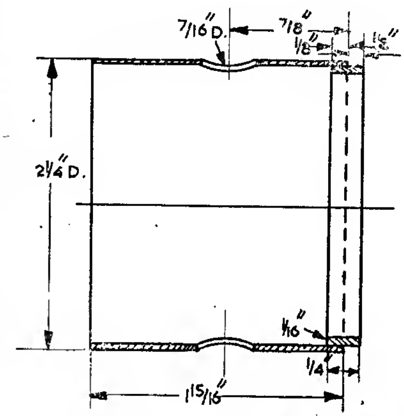
I used three 10 BA brass screws to hold the ring to the smokebox, filing off flush on the outside, the ring being made a nice push fit in the outer barrel.

The door ring could be made from a brass blank 2¼ in. o.d. × ¼ in. thick, a hole 1 17/32 in. dia. being cut by means of a parting tool set crosswise in the lathe toolholder.

Mild-steel strip ¼ in. × 1/16 in. is used for the crossbar, a slot 7/16 in. × ⅛ in. being cut down the centre line to take the dart. This can then be fitted loosely by means of two short strips about 3/16 in. × 1/16 in. riveted to the inside of the door ring in the usual way. It should be possible to remove the crossbar through the smokebox door, and to re-assemble it when required in the same way.

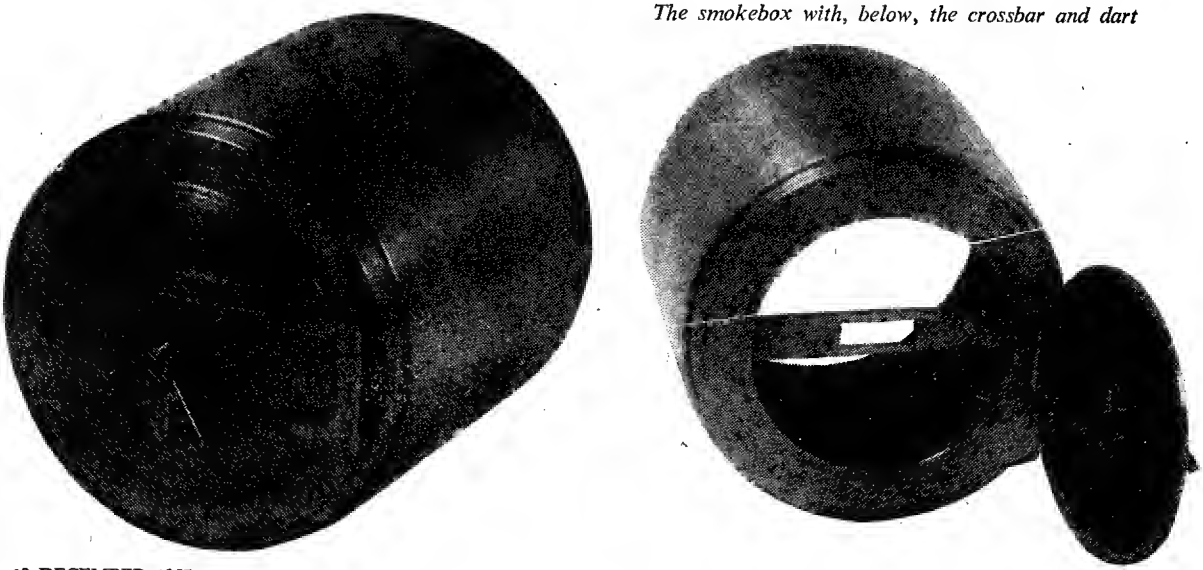
The dart for the smokebox door is a straightforward turning job. A length of ¼ in. × ⅛ in. mild steel is used and is set to run truly in the four-jaw; it is easier to file the "square" while still in the lathe, the short length of thread being put on with an 8 BA die.

Two door handles are required—one being drilled No 50 and tapped 8 BA the other having a square hole to suit the dart. My usual way to produce this square is to drill a hole a shade under the distance across the



SMOKEBOX 20 G BRASS TUBE

The smokebox with, below, the crossbar and dart



square (in this case about 0.080 in. dia.) and gradually open it out with a square needle file, checking against the dart every now and then to ensure a close fit.

The handle part is turned taper in the lathe. Any kind of steel will do or even German-silver. The boss should be drilled a size such that the handle can be pressed in, and it can then be silver soldered, cleaned up and polished. Run the tap or the square needle-file through again—as the case may be—as the handle will probably have run through into the bore.

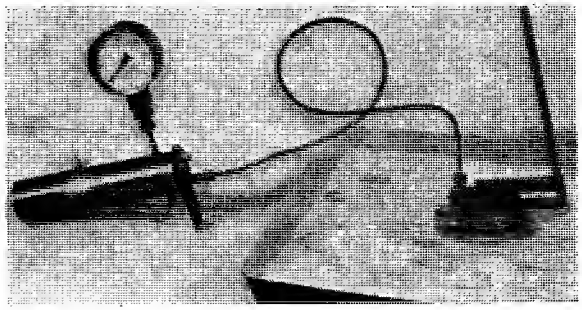
A brass blank is again ideal for the door itself, one 1/16 in. thick being chosen. This should be thoroughly annealed and then "dished" by hammering upon it with the ball end of a medium-size hammer. To finish turn it, drill it No 34 through the middle, and screw on to the end of a short length of round brass rod, say 1/4 in. dia., concave side outwards; soft-solder the joint in addition, so that the door can be mounted in the three-jaw for turning.

Having turned the concave side (the edge *only* by the way), unsolder reverse and re-solder for turning the convex side. Strap-type hinges are shown—I much prefer the appearance of these !—though the short plate type is quicker to make.

As the strap-type hinges are a bit tricky to bend, to form an eye at the end, builders may prefer to file them out of the solid. Brass rivets 1/32 in. dia. were used to fix the hinges to the door.

The centre part of the hinge may be made with a short length of thread, say 8 BA, or, better still, 10 BA and lightly silver soldered for security.

The assembly of the boiler in the outer casing should be simple enough. A No 43 hole is drilled immediately above the regulator bush on the back-head.



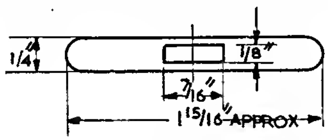
The set-up for the hydraulic test

The boiler is now inserted and lined up in the casing, and the No 43 drill put through this hole, making a centre on the small block fixed to the outer casing. This is then drilled No 49 and tapped 8 BA.

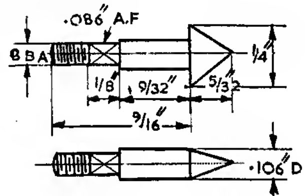
An 8 BA cheesehead screw can now be put in, which will hold everything together, while two further 8 BA screws, countersunk this time, are put through the lower part of the backhead and the back of the firebox and nutted inside.

In my next article I hope to deal with the boiler fittings and cylinder lubricator.

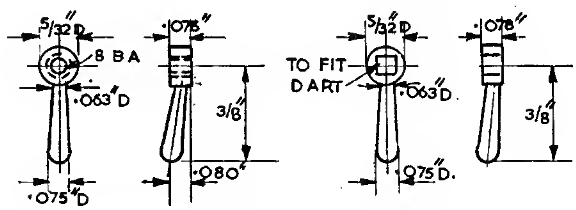
● *To be continued*



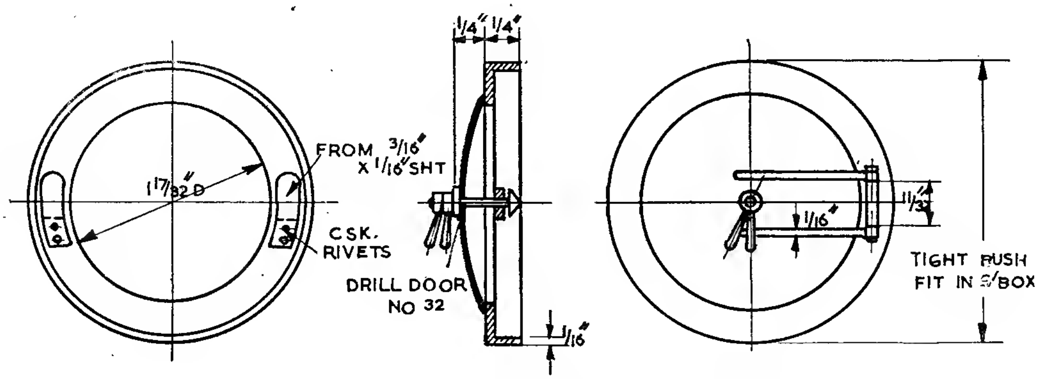
CROSSBAR 1/16" MS



DART M.S.



DOOR HANDLE M S



SMOKEBOX DOOR AND RING – BRASS

THE ME GAUGE 1 LOCOMOTIVE

NEWBURY—7

By MARTIN EVANS

The superheater, displacement lubricator, blast pipe and blower are now dealt with

(Continued from 2 January 1958, pages 6 to 8)

In my last article I detailed the boiler fittings for the gauge 1 4-4-0 locomotive; before you can attach the boiler to the frames there are still a few small parts to make, such as the superheater leader fitting and the cylinder lubricator, etc.

However, before I start on these items, I should like to say a few words on the cylinders specified for *Newbury*.

It has been suggested to me that the design of these is out of date. Well, I agree that the bores are a shade on the small side and that the ports and passages are rather small. But it must be borne in mind that this locomotive is intended for "scenic" work—not passenger hauling—and for the former I consider the cylinders quite suitable.

In any case, I can assure readers that the original *Newbury* seems to have plenty of life in her although the motion is still a bit on the stiff side.

SUPERHEATER HEADER

The header is a very simple affair, consisting of an "elbow," one end of which is drilled $\frac{1}{8}$ in. dia. and tapped 5/32 in. × 40 t., the outside being turned down to $\frac{1}{4}$ in. dia. and threaded 40 t. The other end forms a union for attachment to the superheater.

This is also threaded $\frac{1}{4}$ in. × 40 t; the inside is drilled No 41 to meet the first hole, and a 60 deg. centre completes the operation.

I should, perhaps, mention that the body of the elbow can be made up very quickly by silver soldering the two parts together, but it could also be cut out of the solid quite easily. (I made mine that way—just for a change !)

CYLINDER STEAM AND LUBRICATOR FITTING

A special fitting is required to connect the superheater and the displacement lubricator to the cylinders. This is made from $\frac{3}{8}$ in. square brass rod.

Grip a piece in the four-jaw, face, centre and drill right through with an $\frac{1}{8}$ in. drill, open out with a 60 deg. centre drill to form a union, turn down $\frac{3}{16}$ in. to $\frac{1}{4}$ in. dia. and thread 40 t. Now reverse in the chuck to turn the other end, leaving a $\frac{1}{16}$ in. shoulder of $\frac{5}{16}$ in. dia., the thread again being 40 t.

The central square part which should be 9/32 in. long is now marked off and centre drilled for the steam union fitting, this being offset 5/64 in. from the centre line of the bore. The hole is then drilled 5/32 in. dia. and tapped $\frac{3}{16}$ in. × 40 t.

STEAM UNION FITTING

A section of $\frac{5}{16}$ in. hexagon brass is used for the steam union fitting.

A piece about 1 in. long is chucked and turned down to $\frac{1}{4}$ in. dia. for a length of 19/32 in., and then to $\frac{3}{16}$ in. dia. for $\frac{1}{8}$ in. The latter is threaded 40 t. and the fitting drilled right through 3/32 in. dia.

Reverse in the chuck, turn down 7/32 in. to $\frac{1}{4}$ in. dia. and thread 40 t., finally forming a union seating with a 60 deg. centre drill.

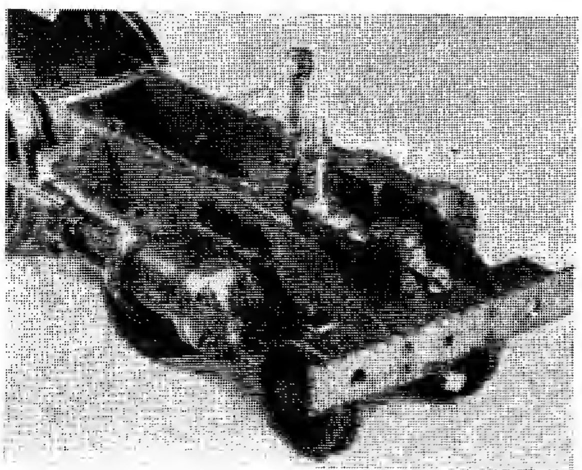
DISPLACEMENT LUBRICATOR

The next item is the cylinder lubricator. There are seven parts in this, two of gunmetal, the remainder brass.

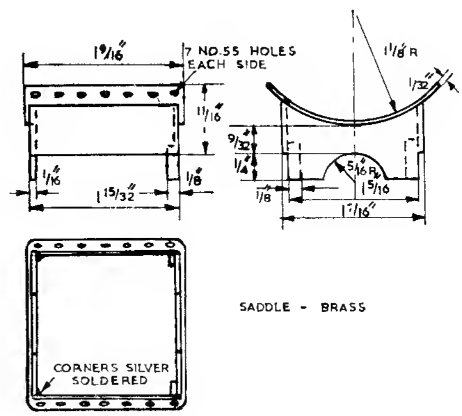
The container itself consists of a length of $\frac{1}{2}$ in. hexagon brass. Cut off a piece about $1\frac{1}{4}$ in. long, face one end and turn down to $\frac{7}{16}$ in. dia. for a length of 25/32 in. Reverse, turn to an overall length of 1 5/32 in., centre, and drill out to 21/64 in. dia. for a depth of $\frac{7}{8}$ in. Tap $\frac{3}{8}$ in. × 32 t., $\frac{5}{16}$ in. deep.

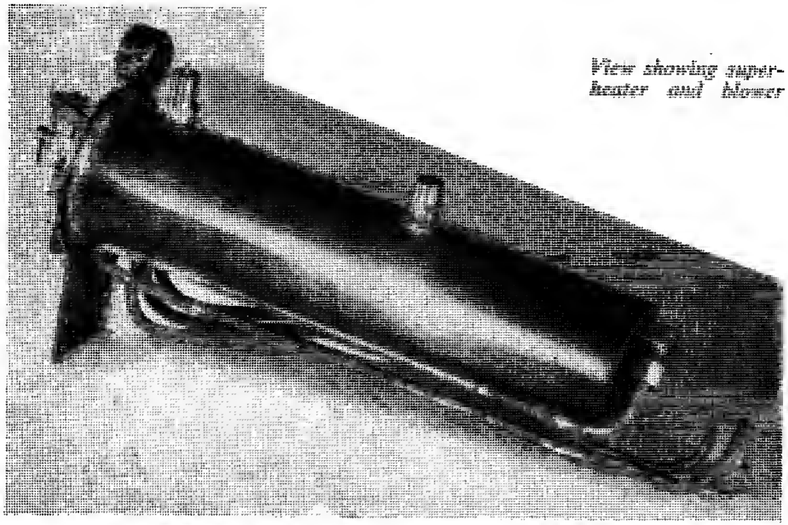
Now mark off on each side of the hexagon end the position of the tapped holes for the steam pipe, these being $\frac{3}{16}$ in. from the top, drilled $\frac{1}{8}$ in. dia. and tapped 5/32 in. × 40 t.

A No 55 hole is now drilled from the bottom of the container at a



Left: View showing lubricator, blast pipe, etc.





View showing superheater and blower

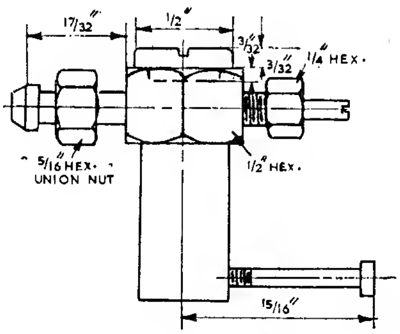
distance of 9/64 in. from the centre. This hole is drilled right through until it breaks into the 21/64 in. dia., so go carefully here or you will be making an unnecessary journey to your tool merchants !

Tap this hole 10 BA for a depth of 3/32 in. only, using a second tap, screw in a brass screw as far as it will go—with a dose of plumber's jointing on the threads—break off the excess and file flush.

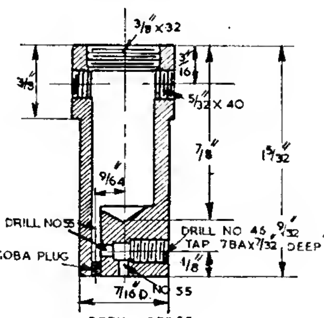
Next, drill a hole from the opposite side with a No 55 drill, $\frac{1}{8}$ in. from the base, so as to break into the No 55 hole previously drilled; open out with a No 46 drill to a depth of 9/32 in. and tap 7 BA $\times$ 7/32 in. deep. This forms the seating for the drain valve.

Finally, another No 55 hole is drilled on the centre line, upwards into the previous hole, so forming the way out for the condensed water.

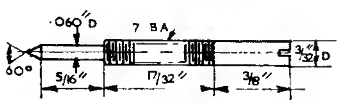
The filler cap is a $\frac{3}{16}$ in. length of round brass rod of $\frac{1}{2}$ in. dia., half of which is reduced to $\frac{3}{8}$ in. dia. and threaded $\times$ 32 t. to match the container. The underside can be hollowed out to advantage, using a $\frac{5}{16}$ in. drill, and a good-size screwdriver slot completes this little item.



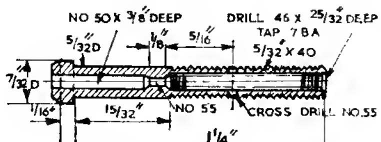
LUBRICATOR



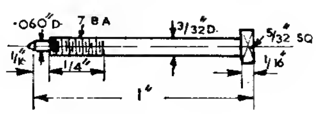
BODY - BRASS



REGULATING PIN
PH BRONZE



STEAM PIPE BRASS



DRAIN VALVE PIN PH BRONZE

Brass rod 7/32 in. dia., or nearest larger size, is used for the steam pipe. Face and turn down $1\frac{1}{4}$ in. to 0.158 in. dia., and thread 5/32 in. $\times$ 40 t. up to 15/32 in. from the shoulder, having your die opened out slightly more than normal to give a tight thread when screwed into the body. Now drill No 55 to a depth of $\frac{15}{16}$ in., open out with a No 46 drill to 25/32 in. depth and tap this 7 BA.

Reverse in the chuck, holding by the plain portion, and turn the usual 60 deg. union cone, drilling No 50 to meet the 55 hole from the other end and finally cross drilling No 55 at 15/32 in. from the plain end.

Now make up a standard $\frac{1}{4}$ in. $\times$ 40 t. union nut about 7/32 in. long, slip over the steam pipe and screw the latter right home into the body of the lubricator. A touch of soft solder each side will make this steam tight.

The regulating pin for the steam pipe is made from 3/32 in. dia. drawn phosphor bronze. A 60 deg. cone is put on one end, and this end is turned down to 0.060 in. dia. for a length of $\frac{5}{16}$ in.

The next 17/32 in. is threaded 7 BA, leaving a further $\frac{3}{8}$ in. of the full 3/32 in. dia. at the other end, which is provided with a small screwdriver slot. This slot will be found more convenient than a hand wheel as it comes right above the front buffer beam. Anyway give me a screwdriver when adjusting under steam . . . these little locomotives get devilish hot !

Another standard hexagon union nut is now needed; this time to fit over the 5/32 in. $\times$ 40 t. thread of the steam pipe, and the regulating pin can now be assembled using graphited yarn for packing as usual.

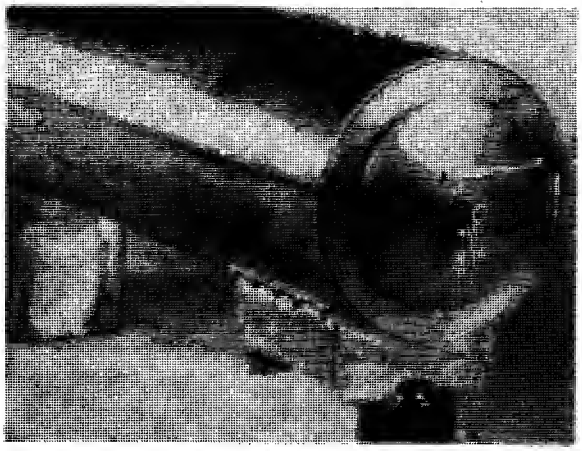
One more item is needed to complete the lubricator—the drain valve pin—and this is almost identical to the steam pin, except that a square or hexagon head is required to stand out just beyond the underside of the buffer beam. Put a "Hallite" washer on the filler cap and try the lubricator in place on the locomotive.

BLAST PIPE

The blast pipe certainly lived up to its name as far as I was concerned ! The reason for this was that I wanted a firm support for the blower pipe and I tried several methods before I hit upon the very simple affair shown in the drawing.

The blast pipe itself consists of a short length of $\frac{3}{16}$ in. dia. copper tube, threaded at each end $\times$ 40 t. This should then be well annealed and bent approximately to lie under the chimney.

The nozzle, which is made from



View showing saddle

$\frac{1}{4}$ in. hexagon brass, is drilled No 43 (it may be found necessary to open this out in practice) and a small piece of brass sheet with a No 29 hole drilled in it is silver soldered to one side as shown; this is then bent to give a slight angle to the blower pipe on final assembly.

The problem now is to screw this nozzle on tightly, while getting the "blower pipe holder" to lie where you want it—which, in this case, is to the right of the blast pipe, looking from the front of the locomotive.

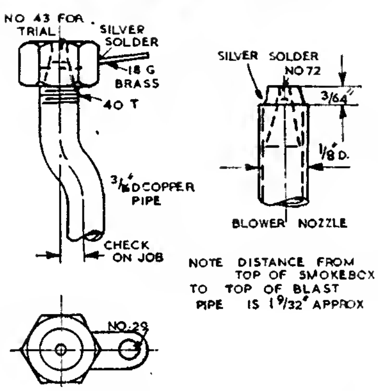
The solution is, of course, to carefully file the top of the blast pipe until the "holder" *does* lie right. And don't forget to apply plumber's jointing !

BLOWER

The blower is very simple, a length of $\frac{1}{8}$ in. dia. copper tube well-annealed and furnished with the usual union and nut to fit the valve on the backhead.

The "business end" is furnished with an internal nozzle, this being simply a tiny piece of round phosphor-bronze rod, drilled No 72, pushed into the end of the tube and silver soldered.

Incidentally, to arrive at the correct length of tube for the blower, don't forget LBSC's very useful tip: bend



up a length of soft iron or copper wire first to the final shape required, then straighten out again and measure. Simple, but very effective !

The blower pipe, of course, has to pass through the backhead and should lie alongside the water tubes (as can be seen in the illustration).

SUPERHEATER

The superheater is just a length of 5/32 in. dia. copper tube furnished with the usual union cones and nuts at each end to match the header and the cylinder fitting, and makes a complete loop back to the backhead and forward again.

The exact length of tube required can be determined as for the blower.

PETTICOAT PIPE

A length of $\frac{7}{16}$ in. $\times$ 20 or 22 s.w.g. brass tube is required for the petticoat pipe, plus a piece of brass sheet about $\frac{1}{16}$ in. thick.

Face the tube to length, anneal thoroughly, and bell out one end as shown. Don't overdo this or the ends of the tube will split. A $\frac{7}{16}$ in. dia. hole is cut in the sheet, the pipe pushed in to the correct position and silver soldered to it.

Two No 50 holes are now drilled each side of the chimney opening (fore and aft) and the drill run through the flange of the petticoat pipe which can then be tapped 8 BA. The holes in the smokebox are opened out with a No 43 drill and countersunk.

SADDLE

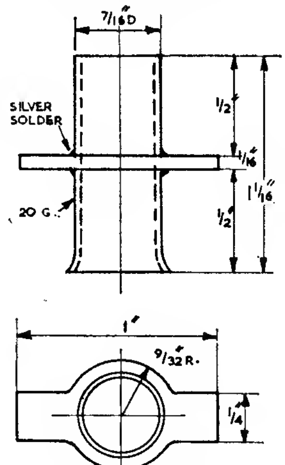
The saddle can be built up from sheet brass quite quickly, about 18 s.w.g. being suitable; the corners could be angled, using $\frac{1}{16}$ in. copper rivets or 10 BA screws, or they could be silver soldered.

The curved piece which lies immediately under the smokebox can be made very easily from a length of the same tube as used for the smokebox.

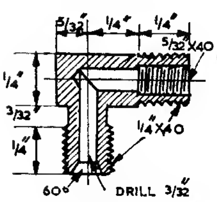
Cut off a suitable length, and flatten very slightly to suit the larger radius required. Silver solder this to the lower part of the saddle, and cut out to clear steam and exhaust pipes, etc.

If you did not use angles in the corners you will need to solder a short strip of brass in the two rear corners to take the fixing screws through the frames. Finally, drill seven No 55 holes each side in the flanges for attachment to the smokebox.

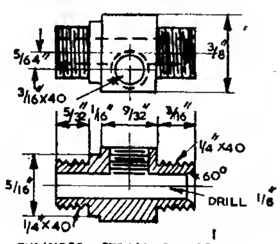
● *To be continued*



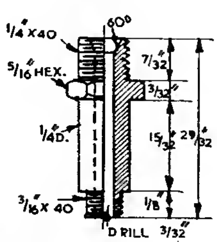
PETTICOAT PIPE BRASS



SUPERHEATER HEADER BRASS



CYLINDER STEAM & LUBRICATOR FITTING BRASS



STEAM UNION FITTING BRASS

THE ME GAUGE I STEAM LOCOMOTIVE

Continued from 16 January 1958, pages 72 to 74

NEWBURY—8

By MARTIN EVANS

The boiler assembly, spirit lamp and pipe work are now dealt with, followed by instructions on the steam test

BEFORE assembling the boiler and smokebox unit, it would be wise to lag the inner boiler as far as possible, with thin asbestos sheet. This should be laid in between the inner and outer barrel and should come down as far as possible without interfering in any way with the pipe work, etc.

If the fit you have obtained between the smokebox and barrel, and between the front ring and smokebox are reasonably close, it won't be necessary to screw these together. In any case it is an advantage to be able to take these items apart easily.

The smokebox is held down to the frames by two 8 BA cheesehead screws, which pass through No 43 holes in the frames, into tapped holes in the rear corner of the saddle.

The firebox end is held down by two 6 BA screws—hexagon head for preference. These should be about 5/32 in. long under the head and are tapped into the frames and then passed through slots in the firebox wrapper so as to allow for expansion. The correct height for the boiler is such that the underside of the barrel is $\frac{5}{16}$ in. above the top edge of the frames.

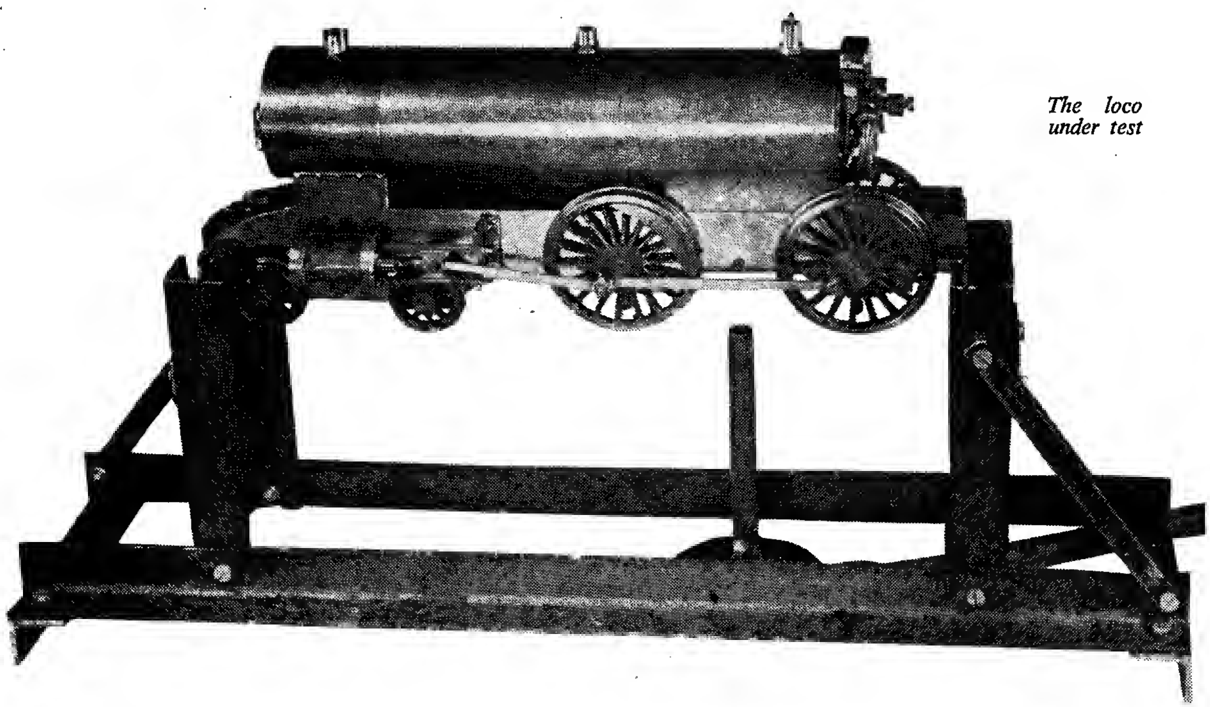
After the boiler is secured, the superheater and blower can be coupled up, the latter being slipped through the bracket affixed to the blast nozzle; the gap around the steam and exhaust pipes is filled with dampened asbestos string.

On my own locomotive at this stage I found that the front end was sagging a bit, so I substituted new springs made of 0.021 in. dia. wire on the driving axleboxes only, the trailing boxes having the original 0.018 in. dia. springs. This effected a complete cure, and the locomotive now rides nicely in working trim.

SPIRIT BURNER

A $2\frac{3}{4}$ in. length of thin brass tube $\frac{1}{2}$ in. o.d. was used as the basis of the burner. This was thoroughly annealed and flattened in the vice until $\frac{3}{8}$ in. thick.

Eight holes for the $\frac{5}{16}$ in. dia. wick



The loco under test

tubes were then drilled and reamed a shade undersize, these being at a pitch of 19/64 in. and on two centre lines $\frac{3}{16}$ in. apart. The ends of the main tube were closed by pieces of $\frac{1}{16}$ in. brass sheet and the wick tubes inserted so that they entered the main tube about $\frac{1}{8}$ in. and stood out such that the whole burner measured 1 in. high overall. The whole lot were then silver soldered.

A $\frac{1}{2}$ in. dia. brass tube—$\frac{3}{4}$ in. length—is again used for the reservoir. This is drilled letter *D* on one side and No 13 on the other so that the pipe from the tender is staggered in relation to the pipe leading into the burner. (This, by the way, helps to prevent surging.)

A short length of $\frac{1}{4}$ in. o.d. brass tube connects the reservoir to the burner and another piece of $\frac{3}{16}$ in. tube with a $\frac{1}{4}$ in. dia. ring completes the assembly—the whole lot being silver soldered as before.

This ring, of course, helps to keep the rubber tube from the tender on safely.

BURNER SUPPORT

The burner support is cut from $\frac{1}{4}$ in. thick brass; thinner could be used, but the more weight the better here, as 4-4-0 locomotives are notoriously front-heavy.

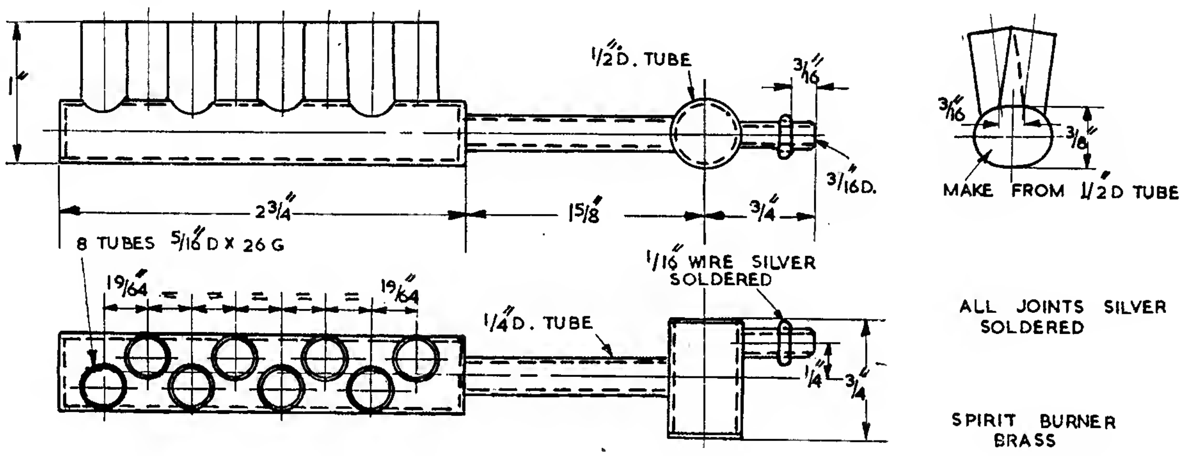
The easiest way to form the $\frac{1}{8}$ in. radius in the main block and cap is to drill a $\frac{1}{4}$ in. hole in the solid and then saw through the middle, cleaning up the two faces with a file.

The support is held between the frames by two **10 BA** cheesehead screws each side, the height being such that the top edge of the support comes $\frac{3}{8}$ in. above the bottom edge of the frames. It will be found that the marking off and drilling for this support can be done through the spokes of the rear wheels without having to remove these from the frames.

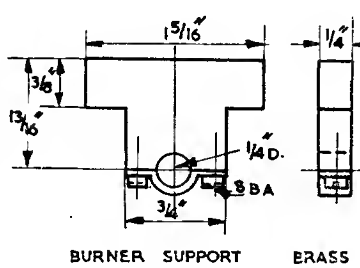
PIPEWORK

The only remaining pipes on the locomotive now are the boiler feed pipe and the waste pipe from the water level try cock. The former is 5/32 in. dia. copper tube furnished with a union nipple and nut, $\frac{1}{4}$ in. × 40 t. at one end, to connect to the check valve, and a similar one at the other end, but with a $\frac{1}{4}$ in. × 26 t. nut for the tender connection.

The pipe should be well annealed in the middle and bent to clear the trailing axle and the burner. A support in the form of a strip of brass about $\frac{1}{4}$ in. × $\frac{1}{16}$ in. screwed to the drag beam will hold the end of the pipe securely.



The spirit burner



The burner support

When fitting this, don't forget to slip it over the pipe with the nuts on each side of it back to back, before silver soldering the second nipple to the pipe. I mention this because it is a job that can be easily forgotten.

The waste pipe from the boiler try cock is $\frac{1}{8}$ in. dia. copper tube; this needs a union nut $\frac{1}{4}$ in. × 40 t. and nipple at one end only. The other end can be adjusted to come out at the side of the locomotive just astern of the r.h. trailing coupled wheel.

STEAM TEST

Now that moment we have been looking forward to has at last arrived! Don't forget, though, that you will need a temporary container for the spirit, with a needle valve to control the flow to the burner before you can get started.

If, however, you have a gas supply handy, plus a bunsen burner, this can be used for an initial test, and it will make steam quicker than any small spirit lamp! Actually I did this myself—in order to run in the locomotive a bit, as the motion was rather on the stiff side.

Roll up some wicks for the burner, using asbestos string or the wicks as supplied for oil heaters, etc. They should go right to the bottom of the burner tube and protrude about $\frac{1}{8}$ in. above the tops of the wick tubes.

Fill the lubricator with steam cylinder oil about two thirds full—a heavy-grade motor oil will also do—and the boiler until water (hot) runs from the try cock. It will be found easier to fill the boiler with all the fittings in the open position, to allow the air to escape.

Now rig up the model clear of the bench with the temporary spirit container on the same level (or slightly above) as the locomotive, place a large sheet of metal or something else fireproof under everything—just in case—and if you have no means of providing an artificial draught, open the smokebox door wide.

NEWBURY . . .

Before lighting up the burner, make sure that the spirit has really reached the wicks. I make no apology for this apparently obvious remark because with the soft type of wick, the tops are easily burnt right off if they are lit before the spirit has been sucked up, and it is an awful nuisance pulling them up again.

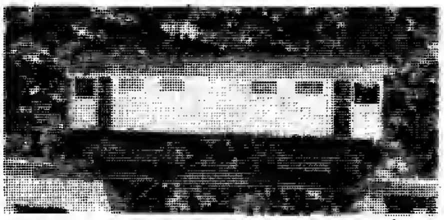
If your chassis is a bit on the stiff side don't expect to find much power at the wheels. In this scale of model initial stiffness can easily take a third off the power available at the wheels.

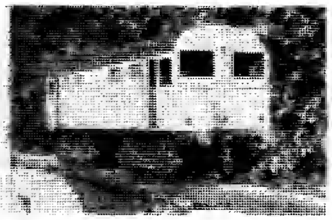
Another point: don't allow the spirit to flow too fast while the boiler has insufficient steam to work its blower. With no artificial draught it may be found that the burner has a tendency to flood, when using a plain spirit tank, but with the blower in operation no trouble should ensue. In any case an auxiliary sump as described by LBSC recently will be specified for the tender, and this should prevent any such antics very effectively.

Well, I sincerely hope your *Newbury* has not disappointed you so far, but if any builders are in trouble I shall be very pleased to offer assistance. Letters, of course, should be addressed care of the Editor.

In my next article I shall be describing the footplate, and "top works" generally.

● *To be continued*





AN ELECTRIC LOCOMOTIVE

By *J. B. RITCHIE*

It is always fascinating to read in ME of people who complete the building of locomotives after ten or twenty years. Their single-mindedness and strength of purpose are admirable, but these virtues cannot always be emulated, and it is hoped, therefore, that these few words may interest those of lesser calibre.

I started to build *Tich* eight years ago when it was being described by LBSC.

It wasn't long before the construction lagged severely behind the articles and, in all, it took about four years to finish *Tich*. In that time, however, a straight track had been built of 1 in. × ¼ in. m.s. flat on precast concrete piers.

When the locomotive was fired up for the first time all sorts of curious things happened: the regulator leaked, steam blew back past the non-return valve into the oil tank, the fire often went out—and when it didn't the supply of steam appeared inadequate.

These things could have been (and will be) put right in time, but circumstances compelled the shelving of *Tich* for future attention.

After 18 months it was felt that something ought to be done about the railway if the children were to get any pleasure out of it.

It seemed that an electric locomotive was wanted. Many inquiries were made for details and drawings, but nothing was available. In fact, the raised eyebrows which these inquiries caused gave the impression that the live-steam men regard electricity with scorn and look on electric locomotive builders as mere rheostat-twiddlers.

It was necessary, therefore, to start from scratch with an original design. The essence of the thing was to build a reasonably good-looking locomotive with the minimum amount of work. After much thought it was decided to base the locomotive on a two-bogie design, and LBSC passenger car bogies were used as being of reasonably light appearance.

I got two 24 v. motors and tests soon showed that to get the necessary power and traction, four motors would be necessary—one for each axle.

The fitting of these motors and their drives on swivelling bogies presented quite a problem. The arrangement eventually consisted of mounting each set of two motors and gearing on a sub-frame above the bogies.

The sub-frame is supported from the axles by legs of Bakelite laminated material which form an excellent bearing surface for the axles which, of course, have to rotate in semicircular recesses in the legs.

The final drive is by chain, and the fact that the motor sub-frame sits on the axles, means that the chain wheel centre distances remain substantially constant when the driving wheels of the bogie move in their spring axleboxes.

The motors are mounted vertically and all drive gearing is Meccano. Unfortunately it is barely strong enough for the job and ought really to be replaced by something more robust.

The reversing controller, with its starting resistances, is mounted between the bogies and is driven by chain from a miniature control handle at one end of the locomotive. One turn of the handle clockwise gives full speed ahead via three intermediate steps, and an anti-clockwise turn does the same thing in reverse. The starting resistances are based on electric fire element wire.

The original idea was to collect the current from a centre rail and return via the running rails, but it was soon obvious that this was impracticable owing to the high resistance due to rust on the running rails, so current now comes and goes by two strips of ⅛ in. × ½ in. aluminium laid on a wooden batten between the rails.

The use of this metal was a mistake because the weather produced a non-conducting film on aluminium which until it wore off, was very troublesome. I should think brass or copper would be much better—though best of all, of course, would be to make the running rails of brass.

Supply comes at 34 volts d.c. from a transformer/rectifier unit, and one side of the supply is earthed. Although the nominal voltage of the motors is 24 they have come to no harm from the higher value.

As an improvement in smoothness of running it was found advisable to install flywheels on the motor armature shafts to increase the inertia. The locomotive takes about eight amp at starting and about two when running. Possibly due to the dirty surface of the aluminium current rails, two pairs of collecting shoes were found necessary.

The power developed is thoroughly adequate and is limited only by the adhesion. It has pulled three large adults—the maximum my truck will take—without any difficulty, and judging by the way it accelerates it could manage a lot more.

No mechanical braking is fitted and is unnecessary, as very efficient electric braking can be obtained by putting the controller in a reverse position to the direction of movement. ▣

THE ME GAUGE I STEAM LOCOMOTIVE

Continued from 30 January 1958, pages 136 to 138

NEWBURY

By MARTIN EVANS

This week, in his ninth article, the author deals with the running boards, cab and splashers of this freelance spirit-fired locomotive

TURNING now to the "plate-work," the next parts to consider are the running boards or platforms.

The shape of these is quite simple as the radii at each end are similar. A suitable material would be 1/32 in. thick hard brass sheet. Equally good would be 20 s.w.g. or 22 s.w.g. steel or brass, though the steel will be harder to bend!

Incidentally, although most people seem to like soft or annealed brass for the bends, I have always preferred hard or half-hard for this. Granted it "springs back" and needs a lot more persuasion to assume the required curve, but the radius produced is more likely to be a true one.

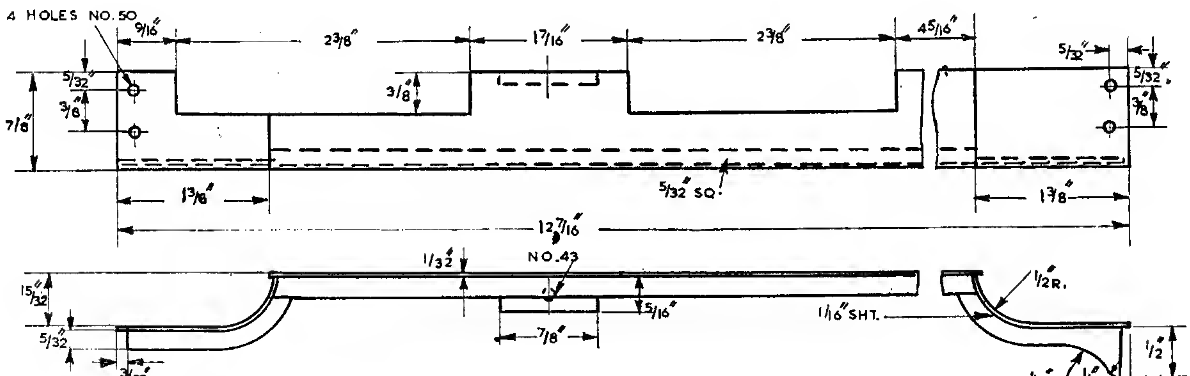
Don't forget to make one r.h. and one l.h. and note that six pieces are required (apart from the edging); two flat and four curved.

To bend the radii then, trim up suitable pieces of your sheet to exact width, but a good bit longer than actually required.

Clamp in the vice—I hope your vice has smooth jaws—with a piece of round steel about ½ in. dia., on the side nearest to you, set exactly horizontal. Check that the sheet brass is lying exactly vertical to both the vice and steel rod and pull the sheet over towards you as far as it will go.

Should the radius be a little out one way or the other, substitute the appropriate size steel rod. The exact length each way from the centre of the curve can then be marked off.

The angle edging, or "hanging-bar" as GW enginemen call it, is best made from 5/32 in. square brass rod, with $\frac{1}{16}$ in. brass sheet for the curved pieces at the ends. All these parts could be silver soldered together, but soft solder is really quite strong enough.



RUNNING BOARD 1 OFF LH 1 OFF RH BRASS RH DRAWN

The running boards

The complete running boards are attached to the buffer and drag beams by two 10 BA round-head screws at each end, into tapped holes in the beams.

To stiffen the middle a short piece of brass about ⅜ in. × ⅛ in. section is soldered between the driving wheels and hard up against the frame; a No 43 hole is drilled in this, in such a position that a screwdriver can reach it without fouling the footplate edging. An 8 BA tapped hole is made in the frames each side to correspond and a short cheesehead screw completes the fixing.

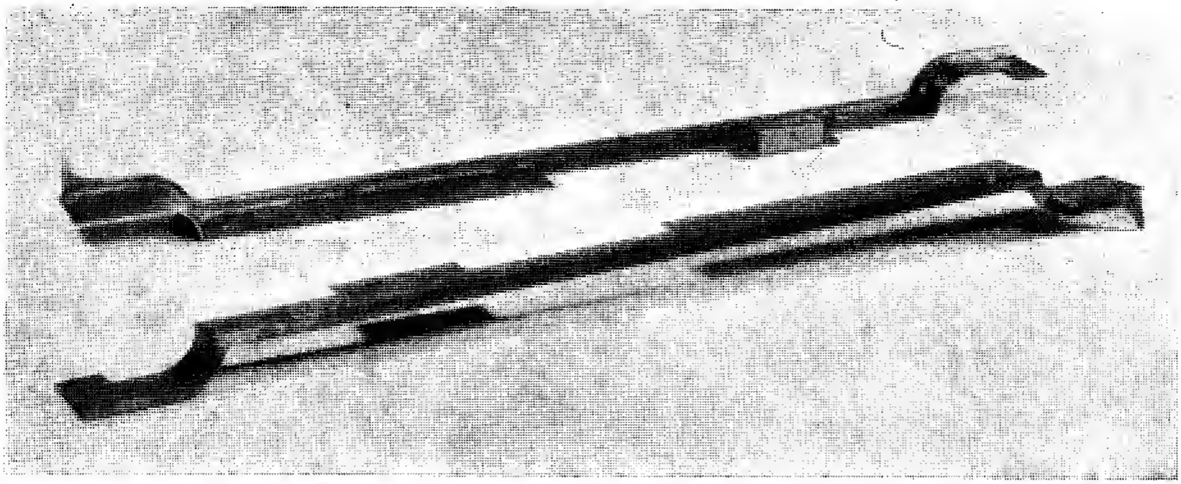
Two further small sections are required to complete the footplating. The rear piece fills in the gap between the backhead and dragbeam, and is flat, but raised from the dragbeam by means of a piece of ⅜ in. square brass bar, $1\frac{5}{16}$ in. long, which is soldered to it. This again helps the weight distribution.

The front piece goes around the lubricator and needs careful fitting to look neat; it also has a radius, similar to or smaller, on its rear edge, to bring it up to the bottom front edge of the smokebox.

THE CAB

On a steam model I always prefer the front of the cab, or "spectacle plate," made in two halves, the join coming on the vertical centre line. This enables the cab to be removed quickly in emergencies, or to get at the boiler fittings.

The spectacle plate is marked out on 20 s.w.g. hard brass or steel sheet and cut out initially as one piece, using a metal fretsaw with No M20 blade.



The part which butts up against the side of the firebox is best left a little oversize to start with so that when the plate is split into the two halves, each half can be "offered up" in turn against the firebox and trimmed accordingly.

To attach the two parts easily, a small piece of $\frac{1}{16}$ in. thick brass is soldered on one part—overlapping the other by about $\frac{3}{16}$ in. or so—and two 10 BA roundhead brass screws are used, passing through No 50 holes in the second sheet into tapped holes in the first.

The cab sides can be cut out together to ensure uniformity, holes are drilled for any handrail knobs required, and short pieces of $\frac{1}{4}$ in. brass angle riveted, screwed or soldered on the two lower horizontal edges for attaching to the footplate.

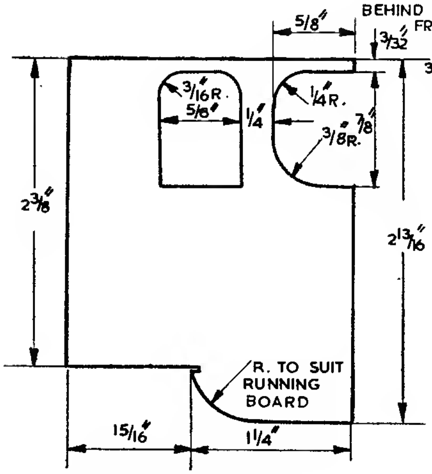
Perhaps the easiest way is to soft solder the pieces of angle first, then drill and tap 10 BA at each end, using a taper tap, and screw in brass screws (any head) as far as they will go. Crop off and file flush. Further pieces of angle are also required to join the cab sides to the spectacle plate and these can be attached in the same way.

The cab roof, which is rolled up from the 20 s.w.g. material once again, can be attached by means of lengths of $\frac{1}{8}$ in. $\times$ $\frac{1}{16}$ in. brass bar soldered along the top edges of the sides at such an angle that the roof lies perfectly against them.

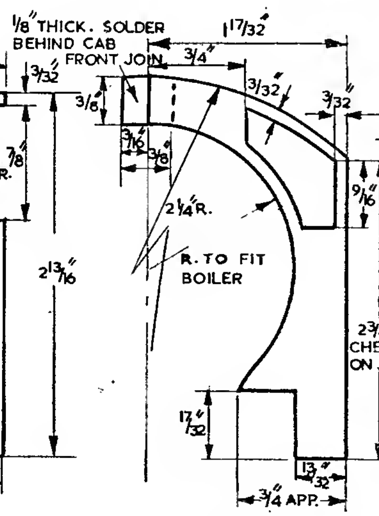
Three or four 10 BA countersunk screws may be used on each side to hold the roof firmly in position.

A rain strip of brass wire about 18 s.w.g. may be soldered along the edges, and possibly a dummy sliding roof ventilator of 16 s.w.g. brass with $\frac{1}{16}$ in. square brass wire for the guides, soft soldered roughly in the middle of the roof, would make a nice finishing touch.

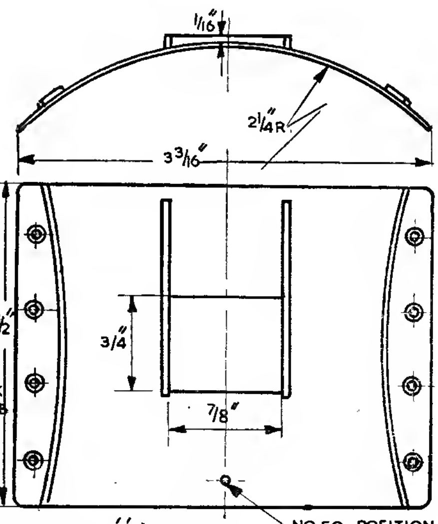
J. N. Maskelyne's original drawing showed a long straight splasher covering both driving wheels. This constitutes less work than the in-



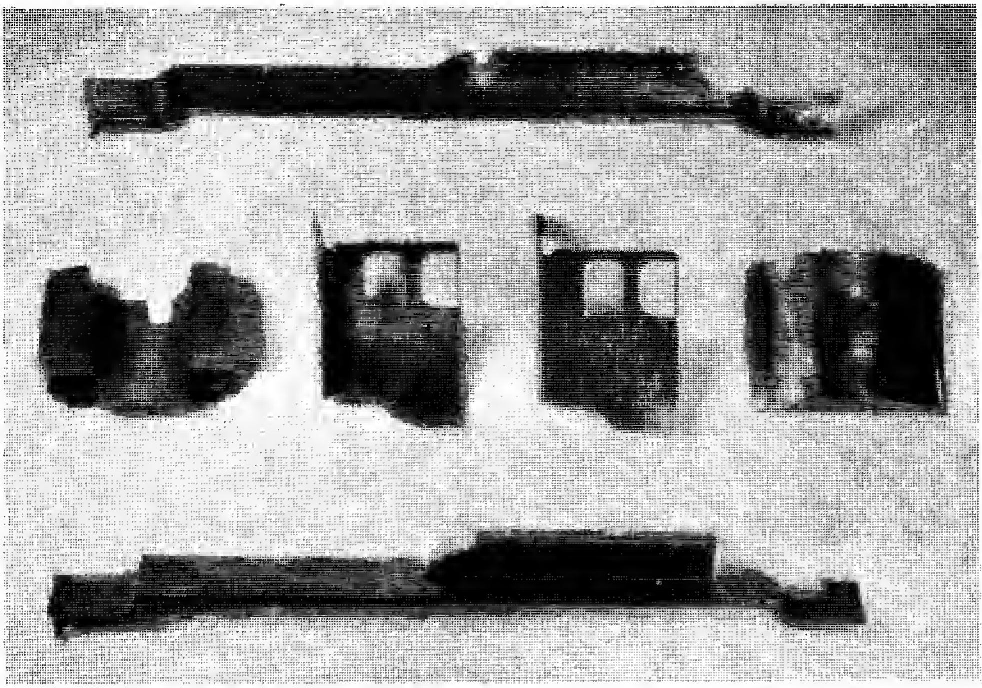
CAB SIDE 20G. BRASS 2 OFF



CAB FRONT 20 G. BRASS
1 OFF L.H. 1 OFF R.H
L.H. DRAWN



CAB ROOF 20 G. BRASS



The footplate and the cab components ready for assembly

dividual type so I don't propose to make the latter! However, please yourself.

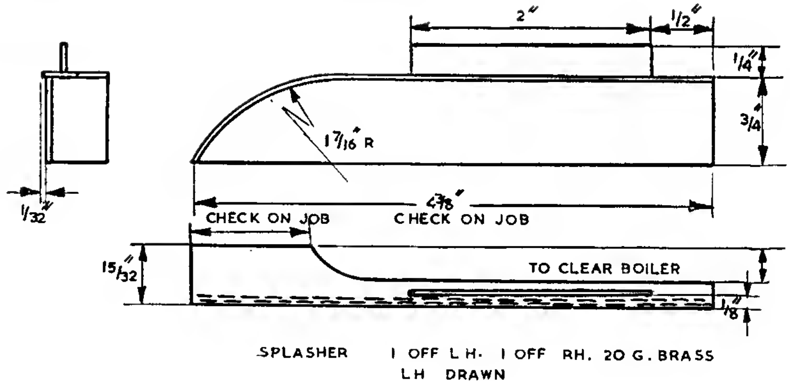
A section of 20 s.w.g. brass or steel sheet can be used as before, and soft solder throughout is plenty strong enough here.

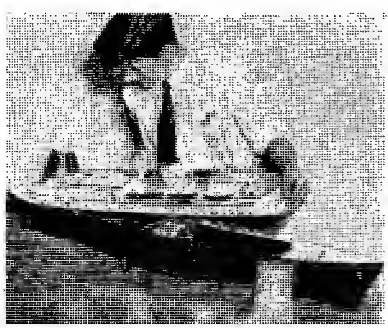
The drawing shows the dimensions but it would be wise to check these carefully against your own model as slight variations may have crept in as the job progressed.

A rectangular plate is shown on which could be mounted an engraving or, if preferred, a name could be painted on.

Next week I hope to deal with that rather tricky business—the turning of the chimney and dome.

● *To be continued*





NEW HONOUR FOR YOUNG MODELLER

The past few months have certainly held their quota of thrills for 15-year-old John Dennys, of Bayswater, West London.

It all started when he built a 4 ft model of the Royal Yacht *Britannia.* First, he was asked to take it to Buckingham Palace so that Prince Philip could see it. Then, when he took it along to the Model Engineer Exhibition, he found himself the centre of attention while his model cruised silently in the Exhibition tank.

Now it is announced that John has won the Exide and Drydex Cup, presented every year by Chloride Batteries Ltd to the builder of the best battery-powered Exhibition model. The cup will have John's name engraved on it and he will keep it for one year. In addition, he will receive a £5 voucher which he can spend at any model engineer supply shop. ▣

THE ME GAUGE I STEAM LOCOMOTIVE

Continued from 13 February 1958, pages 210 to 212

NEWBURY—10

By MARTIN EVANS

This week's article deals with the machining of boiler mountings and with the completion of the locomotive

THIS week we come to those small but very important items, the boiler mountings.

CHIMNEY

I used a casting for this, obtained from one of our advertisers. I think it was actually intended for a GWR King class locomotive, but as Mr Maskelyne originally showed a chimney of somewhat Swindon flavour, this proved no drawback.

As many people prefer to have a fully-dimensioned drawing in front of them when turning a chimney, I am including one taken from my own, but, of course, you are welcome to ignore it if you favour the products of Crewe or Stratford !

Talking of Stratford, there is a strong similarity between the chimney shown on the general arrangement drawing and those fitted to the old GER 1500 class 4-6-0s and the big J20 goods. Fine chimneys these, and fine locomotives too; most of them are still running today !

But to return to our chimney, many model engineers seem to have trouble in making boiler mountings and yet these fittings make or mar a model. How many times have we heard the judges at exhibitions say of a model locomotive: "A magnificent locomotive, except for one small point"?

Here is my way of going about it. Obtain a piece of mild steel about ¾ in. square, and about 3 in. long, drill down one end ⅜ in. dia. × ½ in. long, then drill and tap a 2 BA cross hole at 3/16 in. from the same end, breaking into the ⅜ in. hole. Finally fit a 2 BA cheesehead screw. This constitutes our holder for clamping the chimney casting under the lathe toolholder so that the base can be machined.

In my case, the chimney casting had a chucking spigot top and bottom—jolly useful as I was able to chuck it by the bottom spigot first, while the top spigot was turned down to ⅜ in. dia. (to fit the holder referred to previously).

The holder is now clamped under the lathe toolholder with the centre of the ⅜ in. hole at lathe centre height, the chimney casting inserted and clamped with the screw, and a fly-cutter mounted in the three-jaw chuck. It will save time if the lower chucking spigot is sawn off before starting the machining.

The cutter is, of course, set out a distance equal to the radius of the smokebox—in our case 1⅛ in. (the operation is shown in the illustration) and it is only necessary to cut sufficient away to clean the base up nicely. Incidentally, the fly-cutter consisted of a length of ¾ in. dia. round mild steel with a 3/16 in. dia. round h.s.s. cutter set at right angles and clamped with a ¼ in. BSF bolt.

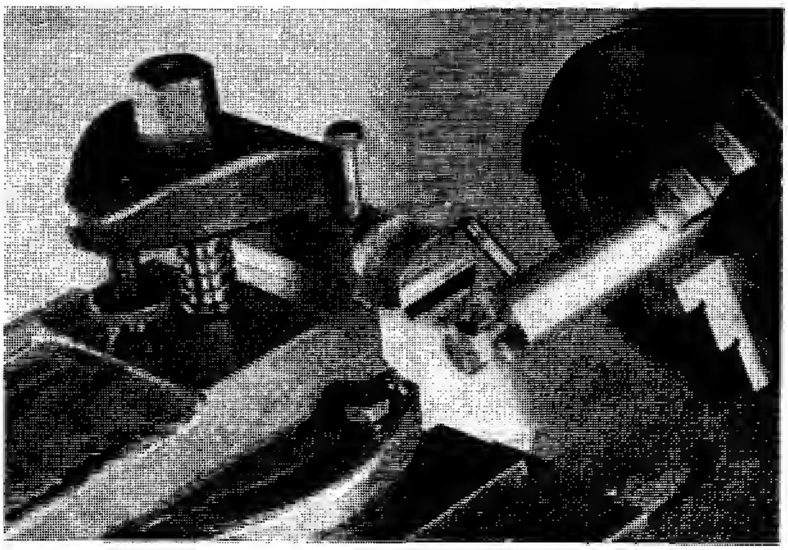
Operation two consists of the machining of the outside and the boring to suit the petticoat pipe, and this is done by holding the chimney by its top spigot in the three-jaw.

Two lathe tools are necessary for chimney turning, a small parting tool with the face square to the job, and a similar tool rounded off both sides (see sketch). The latter tool enables one to produce those difficult radii under the lip of the chimney, and also at the skirt.

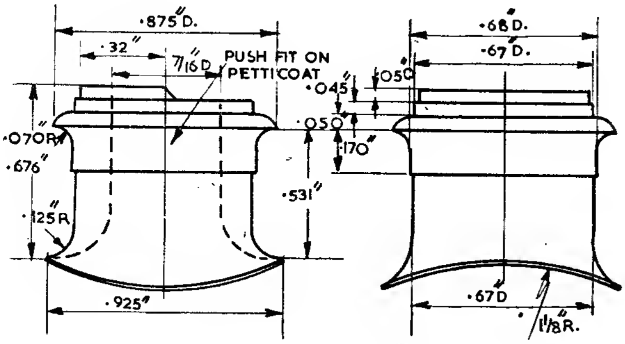
Having produced the desired shape with the aid of these two tools, some cleaning-up will be required and this can be done with needle files and emerycloth.

Note that the skirt on each side cannot be machined away in the lathe without a special set-up, or the part of the skirt fore and aft would be cut away too.

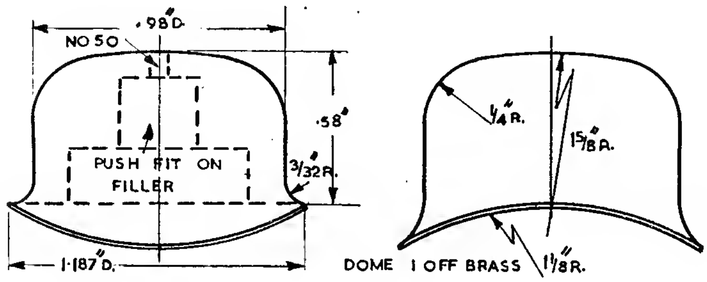
Now drill and ream, or bore, so



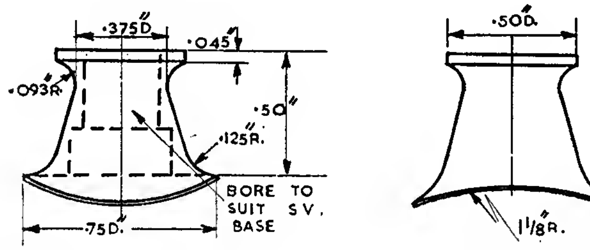
Machining the base of the chimney



CHIMNEY 1 OFF BRASS



DOME 1 OFF BRASS



that the chimney is a nice tight push fit on the petticoat pipe, noting that the chimney will break away from its spigot as the drilling is completed, so go carefully here.

The next operation is to reverse the chimney in the lathe to finish it from the top, and to do this it is necessary to turn a length of brass rod held in the chuck on to which the chimney may be pushed. Friction alone should hold it if your finishing cuts are light.

Finally, the sides of the skirt need to be filed away, and the way to do this is to procure a length of rod or tube the same diameter as the smokebox and to hold the chimney down on to this by a screw and washers.

Use small round and half-round needle files and file on the right-hand side so that if the file slips, it slips away from the chimney. A good deal of patience is required at this stage, but it is here that your chimney will stand or fall.

No, chimneys are not very easy to make!

SAFETY VALVE COVER

My casting for the safety valve cover only had a chucking spigot on the top, so this time I held it by this in the three-jaw, and drilled and tapped a ¼ in. BSF hole in the underside.

A piece of ¼ in. dia. round b.m.s. was next threaded to suit this and the cover casting screwed on so that the chucking spigot could be turned to fit my "holder" for the fly-cutting operation (to ⅜ in. dia. in this case). This was next done exactly as described for the chimney.

The casting was then mounted in the three-jaw by its chucking spigot, the outside turned, and the inside drilled and bored a nice fit on the safety valve proper. As the drilling is completed, the casting will probably break away from its chucking spigot, so go carefully here.

The final operation is similar to the chimney, that is to say, the cover is mounted the other way round on a stub mandrel to finish turn the top and clean the end of the bore if necessary.

DOME

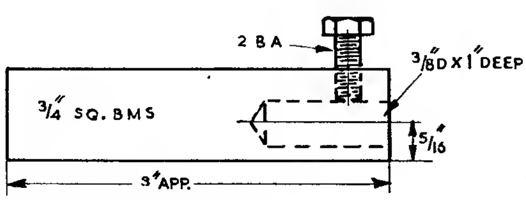
The dome casting I used, again had the chucking spigot on the top, so the work involved in this was almost identical to the safety valve cover, with one important difference—a No 50 hole was drilled through the top so that a 10 BA screw could be used to hold the dome cover down on to the water filler.

Before leaving the subject of chimneys and domes, just a word on the use of brass bar instead of castings. Start by machining a length of bar to a shade over the maximum diameter of the fitting required, then reduce about ⅝ in. of this to ⅜ in. dia. Part off so that there is sufficient of the full diameter to form the chimney or dome required, allowing a little extra for cleaning up.

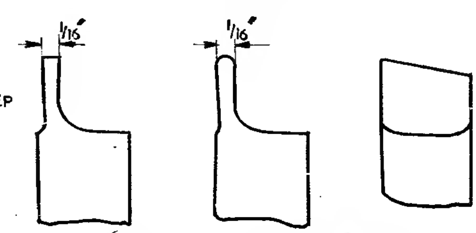
This piece may now be set up in the "fly-cutting holder" and the remaining operations carried out as for castings.

BUFFERS

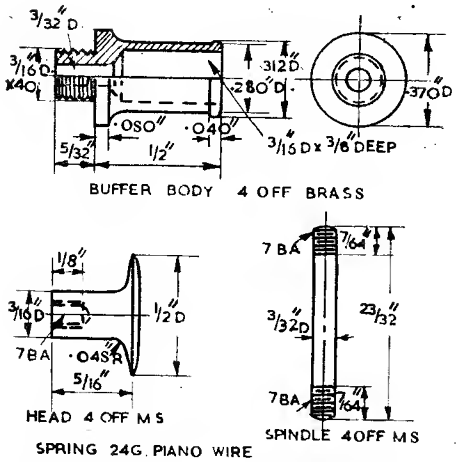
There are five parts to each buffer—head, body, spindle, spring and nut—but they are all quite easy

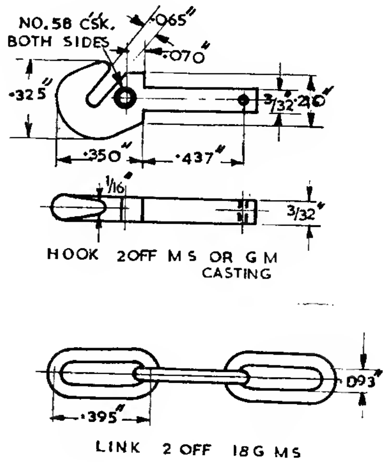


HOLDER FOR FLY CUTTING



TOOLS FOR CHIMNEY TURNING





to make, though I hope you won't need to make the last-named !

The bodies are turned from ⅜ in. dia. brass or gunmetal bar. Machine the threaded ends of all four buffers first. Chuck a suitable piece of b.m.s. in the three-jaw, drill and tap this 3/16 in. × 40 t., to match the bodies, and screw them into this for turning and drilling.

I prefer steel to brass or German-silver for the heads; ½ in. dia. is used here. Turn down the shank first, drill and tap 7 BA × ⅛ in. deep, then part off, leaving a little excess metal for the head proper. Do this for all four, then mount the other way round in the three-jaw for machining the face.

Note that the head should be radiused into the shank, and that the face of the head is only slightly radiused; if you radius them too much they will look like the buffers on some of those pre-war German toy locomotives !

The springs are wound up from 24 s.w.g. piano wire.

COUPLINGS

Castings can be obtained for these, at least for the hook and shank ! Otherwise mild steel strip about ⅜ in. × 3/32 in. can be used. Drill the holes first. The 0.048 in. dia. hole takes 3/64 in. split pin; the 0.058 in. dia. hole should be countersunk both sides to take the links. The top part of the hook should be tapered and all sharp edges should be removed.

The links are made from 18 s.w.g. steel or nickel silver wire. It is not really necessary to braze the links in this scale, but if this is preferred, a small blowpipe and a touch of silver solder will do the trick.

The shank of the hook should slide nicely in the square hole in the buffer-beam and a steel spring similar to that used in the buffers, a washer and a 3/64 in. steel split pin complete the issue.

FINAL DETAILS

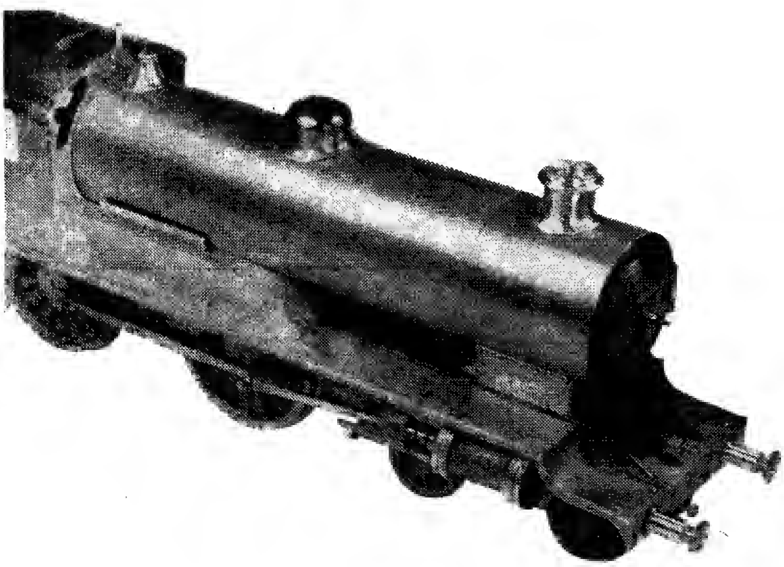
These I propose to leave to the discretion of readers, though a lot of small detail can be rather a menace on a working steam locomotive.

A handrail on the cab sides and alongside the boiler would certainly improve the appearance. Handrail knobs for gauge 1 can be obtained from our advertisers, or they could be made from nickel silver rod as described by LBSC many times.

A dummy vacuum brake pipe finishes the front of the locomotive nicely and this could be bent up from brass wire about 13 s.w.g. (anneal before bending !), the hose being represented by winding 5 amp. fuse wire tightly and securing with a touch of solder at each end against a tiny washer to represent the hose connection.

The cylinders will require a lagging sheet, made of thin gauge blued steel or even thin brass or nickel silver painted dull cylinder black. This can be held in place with four 12 BA round head screws. Be very careful not to drill too deeply for these or you really will be in trouble !

This now completes the locomotive proper and I hope to start on the tender in the next instalment.



View of the finished boiler mountings

● *To be continued*

THE ME GAUGE I STEAM LOCOMOTIVE

NEWBURY—11

By MARTIN EVANS

Things are now nearing completion. This, the last but one article, deals with the frames of the tender and the bodywork

Continued from 27 February 1958, pages 268 to 270

BEFORE going on to describe the tender I should perhaps mention that it is not essential to spring the wheels. If anyone is very anxious to complete the model quickly, a good deal of time can be saved by using dummy axlebox horn and spring castings in one piece.

These can be held to the frames by a couple of 8 BA countersunk screws and the journal holes drilled from the back, unless these are already in the casting, when the latter will have to be carefully located on the frame to ensure that all wheels are level.

However, I hope builders will take the extra trouble and spring the wheels, especially as all the locomotive wheels are sprung. The running, especially over rough track, will be a lot smoother. So I shall give drawings and instructions for the fully sprung tender and will mention any variations required for the unsprung edition as I come to them.

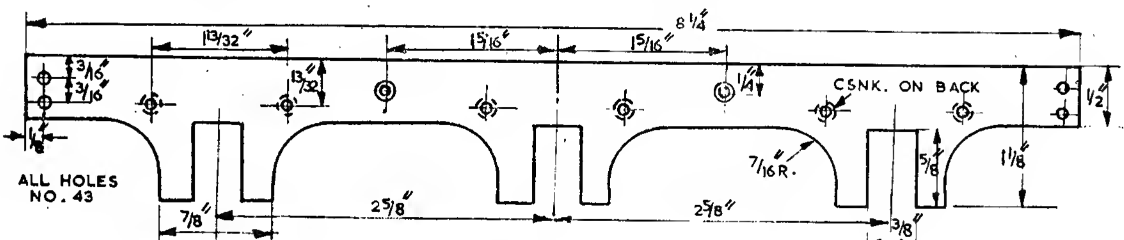
TENDER FRAMES

These are cut from $\frac{1}{16}$ in. thick bright mild steel, two pieces $8\frac{1}{4}$ in. × $1\frac{1}{8}$ in. being required. Mark out one strip, drill a couple of the holes near the ends, then bolt or rivet to the second strip, drill all the remaining holes, and saw and file to outline.

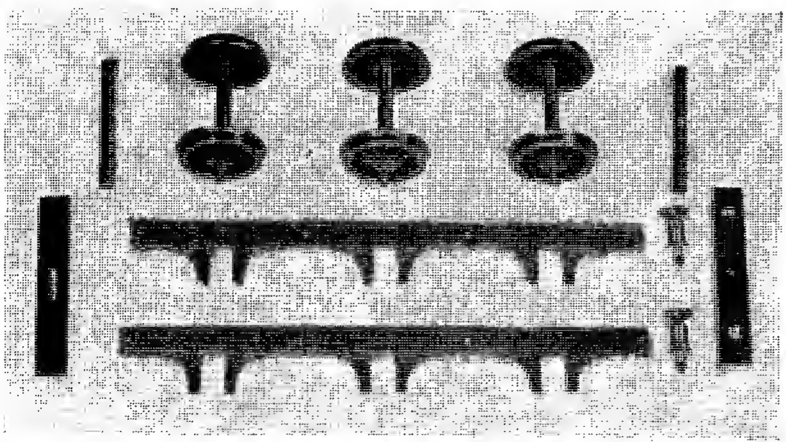
Note that there are two No 43 holes to be countersunk on the outside (these are for the frame stretchers) and six more on the inside to take the screws holding the dummy springs to the frames.

The slots for the axleboxes should be sawn and filed, using a piece of $\frac{3}{8}$ in. square brass bar (later to be used for the axleboxes) as a gauge. The bar should be able to slide up and down quite freely but without appreciable shake.

For the unsprung tender, the axlebox slots will not, of course, be required at all; also the six holes countersunk on the back will have to be placed according to the one-piece casting being used. Another point—locate these castings so that the flanges of the tender wheels do not quite reach the underside of the tender floor (i.e. the top edge of the frames).



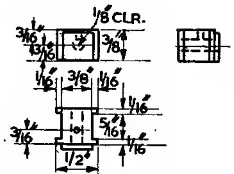
TENDER FRAME 2 OFF 1/16 MS



The tender frames, beams and wheels

The two frame stretchers are simply $2\frac{7}{16}$ in. lengths of $\frac{1}{4}$ in. dia. round mild steel, tapped 8 BA at each end to a depth of $\frac{3}{8}$ in. with a No 42 hole cross-drilled through the centre. Note: drill the ends No 48, not No 50 as it says in the "book," and use tapping oil, then there won't be any broken taps or bad language !

Brass angle, $\frac{1}{2}$ in. × 16 s.w.g., is again used for the buffer and drag beams. In the former, drill No 21 and tap $\frac{3}{16}$ in. × 40 t. for the buffers, and cut a 3/32 in. square hole for the coupling as on the locomotive. The slots for the frames can be cut as



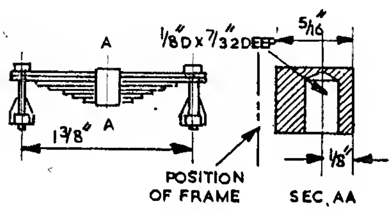
TENDER BEARING

before with a metal fretsaw. Finish off with a flat needle file until the frames are a nice push fit in the slots.

As on the locomotive, $\frac{5}{16}$ in. × $\frac{5}{16}$ in. × $\frac{1}{16}$ in. brass angle is used to fix the frames to the beams. I suggest $\frac{1}{16}$ in. dia. copper rivets between beams and angles, and two 8 BA steel cheesehead screws (to each corner) to hold the frames to the fixing angles.

TENDER AXLEBOXES

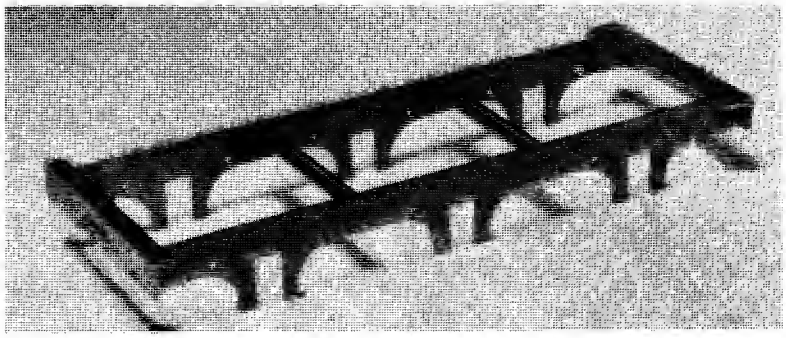
These can be made from $\frac{3}{8}$ in. square brass bar, the flanges being



TENDER DUMMY SPRING
6 OFF BRASS CASTING

cut from $\frac{1}{2}$ in. × $\frac{1}{16}$ in. brass strip and soft soldered on front and back; if the soldering is sound it is not really necessary to pin as well. Alternately, the boxes could be milled from the solid, in which case $\frac{1}{2}$ in. square bar should be used.

Parting-off the boxes to length was fully covered when dealing with the main axleboxes (ME October 10) so I won't bore you with unnecessary repetition. One difference though—you will need an $\frac{1}{8}$ in. dia. hole in the top to take the spring instead of the lower tapped hole, but don't put this in yet as it is easier to drill this from the spring buckle of the dummy casting.



The tender frames assembled

For the unsprung tender, the holes for the journals may be already cast in, in which case open these out with a $\frac{1}{8}$ in. dia. drill, and locate the castings on the frame by drilling $\frac{1}{8}$ in. holes in the correct running position first, then clamping each casting in position with a peg of $\frac{1}{8}$ in. round material in the box. The drill can then be run through the frame holes above and centres made in the casting, which are then drilled out No 50 and tapped 8 BA.

When the one-piece castings are fixed in this way, open out the holes in the frames with a No 29 drill, but be very careful to ensure that the drill doesn't run into the axlebox proper. The idea of this, of course, is to arrange that the axle journal runs in the brass axlebox rather than the steel frame.

If the one-piece castings have no axle holes cast in, screw them all to the frames first, then mark out on the back of the frame the correct position for these holes and drill $\frac{1}{8}$ in. dia., finally opening out as above.

TENDER DUMMY SPRINGS

For the sprung tender, some quite nice castings are available from one of our advertisers for the dummy springs, so it is hardly worth while going to the trouble of building these up. The castings I used measured $1\frac{3}{8}$ in. across the centres of the spring pins. The backs of these should be carefully filed so that they lie nicely on the frame without wobble, and the details can be cleaned up a little with needle files.

A $\frac{1}{8}$ in. dia. hole is then drilled into the bottom of the central spring buckle, to a depth of about 7/32 in. and at a distance of $\frac{1}{8}$ in. from the front face.

To hold the springs to the frames, two 8 BA steel countersunk screws are used to each; line up the tops of the springs against a length of 5/32 in. square rod held flush with the top edge of the frame. (I say 5/32 in. because that will be the size of the tender footplate edging.)

TENDER HORNS

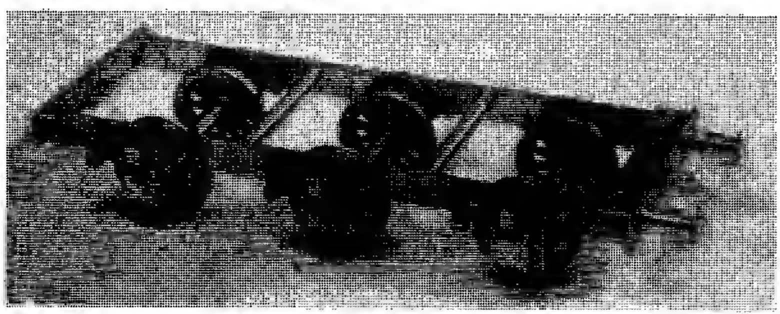
Castings are also obtainable for these, although I built mine up from $\frac{1}{4}$ in. brass angle. I think the built-up ones look neater and they don't take so very long to make especially if one makes a simple jig to hold the little bits of strip forming the webs.

Cut off 12 $\frac{1}{2}$ in. lengths of the angle and square up the ends. Now obtain a piece of hardwood, any convenient size, and drive in panel pins to hold the horn and the two lengths of strip which will form the webs (see sketch). A suitable size strip would be $\frac{3}{16}$ in. × 1/32 in.

The heads of the panel pins should, of course, be cut off and the tops of the pins bevelled slightly so that the parts can be slipped in without difficulty. A touch of Baker's fluid and, if the parts are clean, the soft solder will run around the webs and form a nice fillet. On removal from the jig, the excess strips can be cut off, the webs trimmed up, and the next angle piece inserted.

A simple jig like this only takes a few minutes to make and does ensure all the horns coming out alike !

Drill the horns with three $\frac{1}{16}$ in. holes equally spaced between the



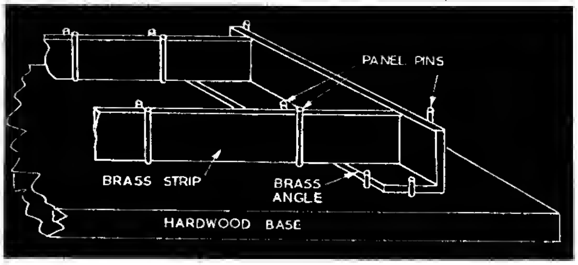
The tender chassis assembled

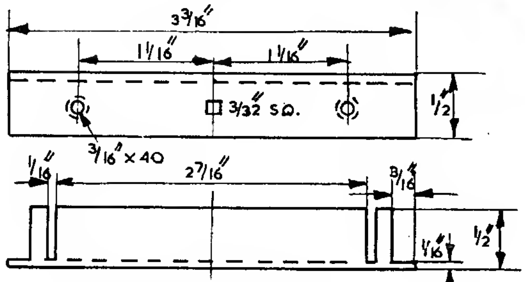
webs, line up on the frames with an axlebox temporarily in position, then clamp with a small toolmaker's clamp, remove box, and run the drill through the frames, countersinking these holes lightly on the backs.

I used $\frac{1}{16}$ in. copper snaphead rivets here, the ends being lightly hammered into the countersinks.

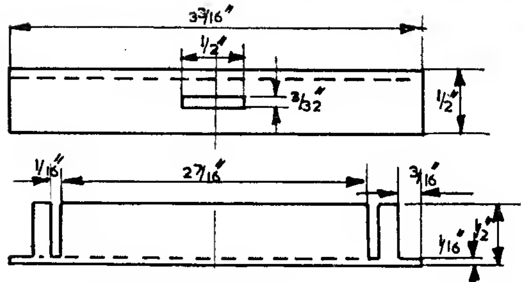
The hornstays are simply $\frac{7}{8}$ in. lengths of $\frac{1}{8}$ in. $\times$ $\frac{1}{16}$ in. flat brass strip, and these are held in place by

Jig for making tender horns

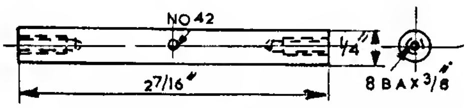




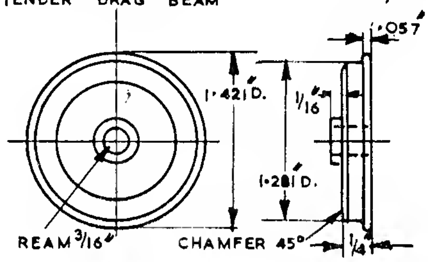
TENDER BUFFER BEAM



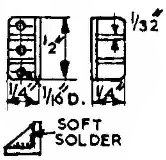
TENDER DRAG BEAM



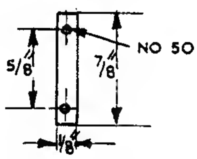
TENDER FRAME STRETCHER 2 OFF M S



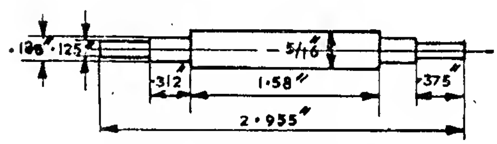
TENDER WHEEL 6 OFF CI



TENDER HORNS
12 OFF BRASS



HORN STAY
6 OFF 1/16 BRASS



TENDER AXLES 3 OFF M S

two 10 BA roundhead or hexagon-head screws.

WHEELS AND AXLES

As I covered wheel and axle turning fairly thoroughly in my article of October 24, there is little more to say regarding those for the tender. However, with reference to the axle wheel-seats, I should perhaps mention that I incorrectly stated (in the above article) that these could, if desired, be turned very slightly taper. What I should have said, of course, is that the first quarter or so of the wheel seat could be very slightly tapered.

Actually I always do this with a file, and I doubt if more than $\frac{1}{2}$ thou is removed; the remaining three-quarters being parallel will ensure a tight fit.

Before assembling the frames of the sprung tender, the axleboxes will need drilling to take the springs, so mark off the correct position for this, which can be obtained easily by applying "odd-leg" callipers to the spring in position on the frame and applying the setting to the axlebox. Drill this hole $\frac{1}{8}$ in. dia., not quite through into the journal hole, then follow up with a small drill (say No 68) which is run right into the latter.

Suitable springs can be wound up using **0.016** in. dia. piano wire on a mandrel of about **0.085** in. dia.

The frames can now be assembled and to ensure their going up true, lay the whole affair on the surface plate or lathe bed before giving the final tighten up.

In the next and final article I hope to cover the body of the tender and the interior fittings.

● *To be concluded*

Next week's reading . . .

Wilbur J. Chapman, writing from Chicago, introduces readers to the wonderful steam museum at Dearborn, near Detroit, built by the motor pioneer Henry Ford, and Edward Bowness, in his third *Cutty Sark* instalment, completes the instructions for carving the hull, fitting the bulwarks, covering the decks and making and fitting the pin rails.

Two calamitous train disasters within a short space of time—Lewisham and Dagenham—has brought the subject of automatic train control into sharp focus. A condensed version of the address given by John H. Currey to The Institution of Railway Signal Engineers together with photographs and drawings of the apparatus will help readers to keep abreast of the latest developments in this technique.

THE ME

GAUGE I

STEAM

LOCOMOTIVE

NEWBURY—12

By MARTIN EVANS

The author concludes this series with the final tender details and some notes on the painting of the model

Concluded from 13 March 1958, pages 326 to 328

COMING now to the body of the tender, the floor, sides, back and inside sheets can again be made from the 20 s.w.g. brass. The floor is just a plain rectangle with the corners slightly radiused, to which is soldered the 5/32 in. square edging (this to fit between the buffer beams) and the six screws which hold it down to the chassis.

Of these screws, which are 8 BA brass cheesehead, four pass through the corners of the buffer beams and are nutted underneath, while two pass through the holes in the frame stretchers. The two latter will need washers of appropriate thickness between floor and stretcher to prevent the former being distorted when the nuts are tightened.

The sides and ends are each made in two pieces as shown, the upper part, forming the coal sheet, overlapping the lower. Soft solder is quite all right here; a large plain copper bit or a Solon industrial type electric iron will do the job nicely.

It is not really essential to use angles to hold the sides and ends together—a good fillet of solder all round is sufficient.

As the end goes " inside the sides " so to speak, I usually find it easier to solder the end to the floor first. Do not be tempted to use a blowlamp or bunsen burner on the job or something is sure to distort, and once distortion sets in the only cure is usually to strip everything down and start all over again!

In a previous paragraph I referred to the soldering of the sides and end of the tender body to the floor. It will now be noticed that the lower part of the sides and end form a very convenient " ledge " on which to rest the tender top plate, so before going any further, solder a length of $\frac{1}{4}$ in. brass angle across the back of the tender (inside—I need hardly add!) at the same height as this ledge.

The top plate can now be cut out, a rectangular slot for the filler hole and hand pump extension lever being required in this as shown. A division plate, with another piece of $\frac{1}{4}$ in. brass angle soldered to it, can now be fixed in position, the top plate being used as a gauge. Four 10 BA brass roundhead screws will be ample to hold the top plate down securely.

A further division plate with a curved top edge is then soldered to the removable top plate to represent the division between the coal and the water space on the full-size job.

The next items are the spirit tank and the sump. This latter, by the way, is based on a design of LBSC's of some years ago, and ensures a constant supply of spirit to the burners without the danger of flooding.

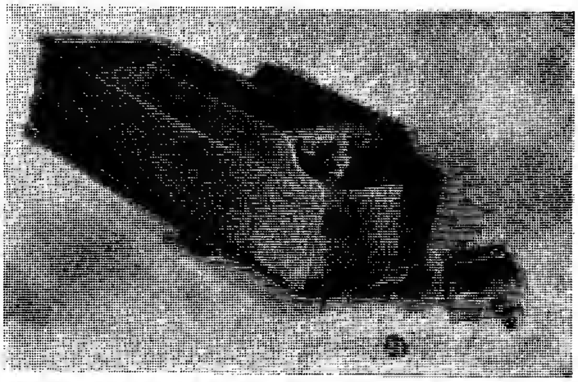
Cut out the top and front of the spirit compartment first, mark out and drill the former for the filler bush and the upper bush of the spirit valve. The filler plug is turned from $\frac{3}{8}$ in. brass hexagon and is threaded $\frac{5}{16}$ in. $\times$ 26 t. to match the bush, turned from $\frac{7}{16}$ in. round material.

I have specified a large filler as there is nothing more annoying than one that is too small to absorb the fuel quickly. One always seems to be in a hurry to get one's model under steam.

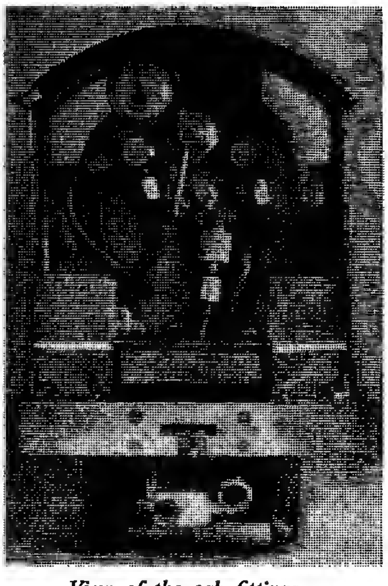
Coming to the spirit valve, the upper fitting is turned from $\frac{5}{16}$ in. round brass, one end being turned to $\frac{1}{4}$ in. dia., the other being threaded $\frac{1}{4}$ in. $\times$ 40 t. to take a gland nut as shown. Solder these two items into the top plate of the spirit compartment, but don't fit it to the tender yet.

The sump is bent up from 20 s.w.g. brass sheet once more, and should come down a maximum of $\frac{3}{8}$ in. from the tender floor.

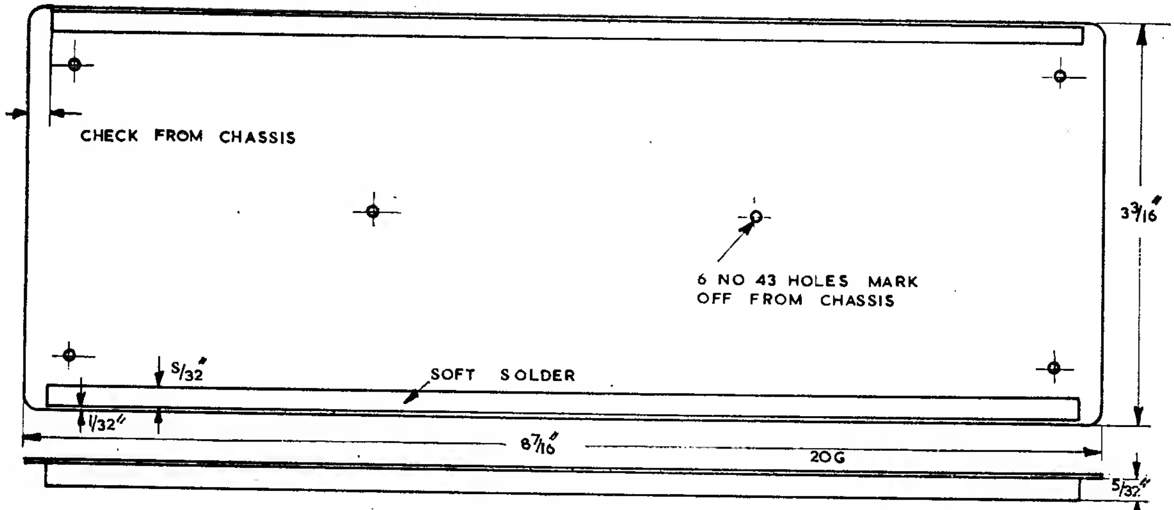
For the spirit outlet, fit into this a



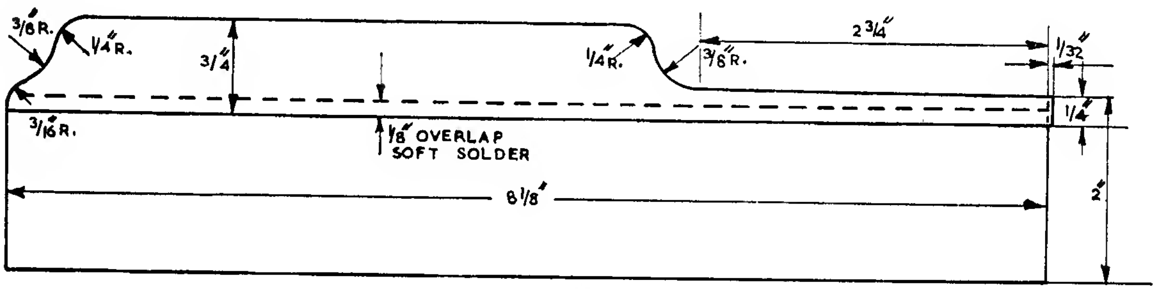
Left: The tender body with the spirit sump



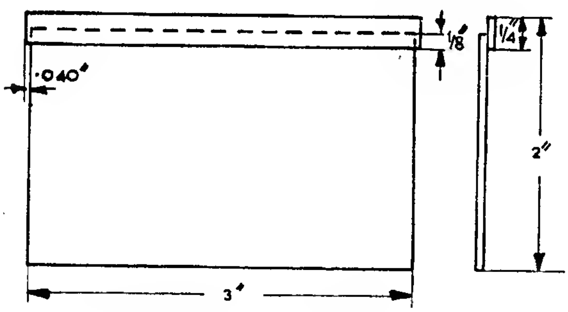
View of the cab fittings



TENDER FLOOR 20 G. BRASS



TENDER SIDE 20G BRASS



TENDER BACK 20 G BRASS

Components of the tender body

½ in. length of $\frac{3}{16}$ in. brass tube, with a little ring to help to keep the rubber tube in place, and bend this tube to line up nicely with the corresponding pipe on the locomotive.

Four 6 or 8 BA roundhead brass screws are used to hold the sump to the underside of the tender floor; put the screws in from above and solder over the heads so as to make everything watertight (sorry—spirit-tight !).

Next cut the ¼ in. dia. air pipe, the bottom end being cut off at an angle, and fit this so that the bottom edge is about ⅛ in. above the floor of the sump. The lower fitting of the spirit valve can now be made. This is turned from ¼ in. dia. brass rod, being drilled No 52 right through, opened out with a No 31 drill and tapped 5/32 in. Whitworth. It is then cross-drilled No 55 just above the "valve-seat" for the spirit way.

The top plate can now be soldered in place and a 5/32 in. drill run through the upper fitting to locate the position of the bottom fitting which can then be fitted.

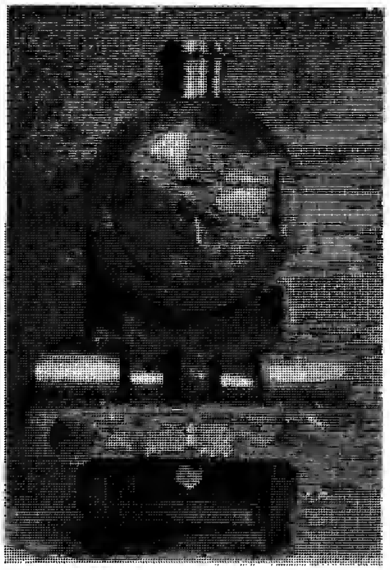
Make up the valve spindle next, 5/32 in. dia. phosphor-bronze being very suitable. One end is threaded 5/32 in. Whitworth, and given a 90 deg. point, the other is shaped as shown and cross-drilled a press fit for a piece of 15 s.w.g. wire bent to form a handle. The gland nut at the top end can now be packed with graphited yarn, when the container can be boxed in completely with the front plate.

TENDER HAND PUMP

Some ME advertisers can supply castings for the tender hand pump, and I would recommend using one in preference to building the pump up. As to capacity I suggest ⅜ in. bore × ½ in. or ⅝ in. stroke.

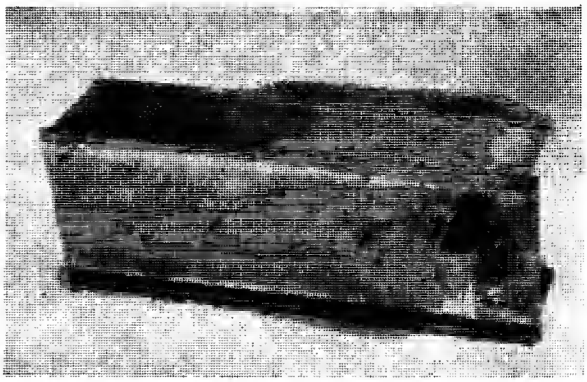
The first operation on the casting is to hold in the four-jaw chuck for drilling and reaming the barrel; face the outer end at the same setting. Turn the casting around in the chuck and line up the valve box, face the end, drill No 23 and ream right through 5/32 in. dia.

Now open out with 7/32 in. dia. drill to form the upper valve seating, but be careful not to go too deep and break into the main bore. Follow the



Front view of the locomotive

Right: Underside of the tender



drill with a 7/32 in. dia. D-bit or end-mill to square the end of the hole, then tap ¼ in. × 40 t.

Reverse the casting in the four-jaw and line up the valve box again for machining the suction passage. This means, in effect, getting your 5/32 in. dia. bore running true. Open out with 7/32 in. dia. drill, using the same precautions as before, and tap ¼ in. × 40 t. Don't forget to notch the waterway here otherwise the suction ball will block the "way-in."

A valve seat is formed in the top for a 3/16 in. dia. rustless steel ball in the usual way. If the seating is at all close to the main bore, it would be advisable to plug this temporarily with a piece of ⅜ in. dia. material when fitting the ball.

The bottom fitting is turned down and threaded ¼ in. × 40 t. from 5/16 in. brass hexagon bar, drilled and reamed 5/32 in. dia. and a valve seating formed on the top as before.

The top cap is similar except that it is not drilled at all and the two fittings should be arranged for 1/32 in. lift on the balls.

A union fitting is turned from ¼ in. dia. brass for the delivery pipe, thread one end 3/16 in. × 40 t. for attaching to the valve box, the other end ¼ in. × 40 t. Drill No 41 and form a union seating with a centre drill. This fitting and the top cap should be screwed home with a touch of plumber's jointing on the threads.

Rustless steel is used for the ram. Turn a groove near one end for the usual graphited packing. At the other end drill a ⅛ in. dia. cross hole and slot ⅛ in. wide for the lever.

This can be done very quickly in the lathe by clamping the ram under the toolholder and bringing up to a ⅛ in. thick slotting cutter. Run the lathe at its lowest speed and use plenty of coolant. (This applies to drilling, by the way; some of these rustless steels are nasty things to drill.)

The lever consists of a short length of brass strip ⅛ in. × ¼ in. section and the two links ¼ in. × 1/16 in. The three pins should be of rustless steel or phosphor-bronze ⅛ in. dia. and furnished with 5 BA brass nuts each side.

The completed pump can now be located in the tender body, with the handle under the centre of the water filler when in an upright position. It is bolted down with four 6 BA brass roundhead screws, the heads being underneath and soldered over to keep the whole affair watertight.

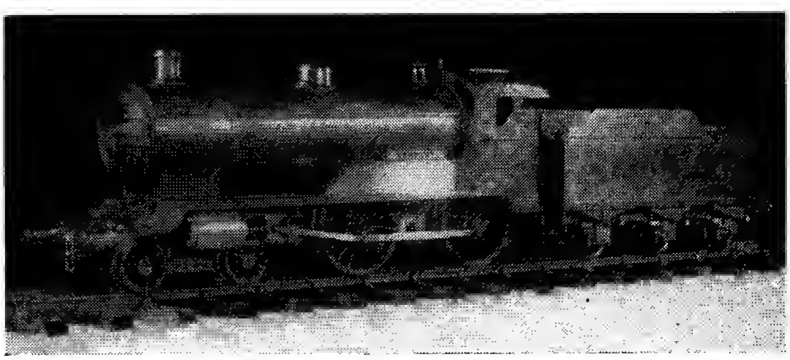
Coming now to the pipework, a small fitting is required to form a connection between the inside and the outside of the tank. This is quite simple, being turned from ⅜ in. square brass in the four-jaw; one end is turned down and threaded ¼ in. × 40 t. and drilled No 41, a union seating being formed at this end as usual. The other end is drilled at right angles for another female-end union of the same size.

This fitting is put in from the outside, through a hole just ahead of the pump and a little to one side, and lock-nutted on the inside. A short length of ⅛ in. dia. copper tube furnished with union nipples both ends, plus two nuts, connects this fitting to the pump.

The ⅛ in. dia. pipe from underneath the tender tank to the union on the locomotive needs plenty of flexibility, to allow for the sideways movement between the engine and tender on curves, so bend this up with a couple of coils in it, situated between the middle and rear axles, the pipe terminating under the footplate in line with the union on the locomotive. To do this, of course, you will need to assemble the tender body on its frames.

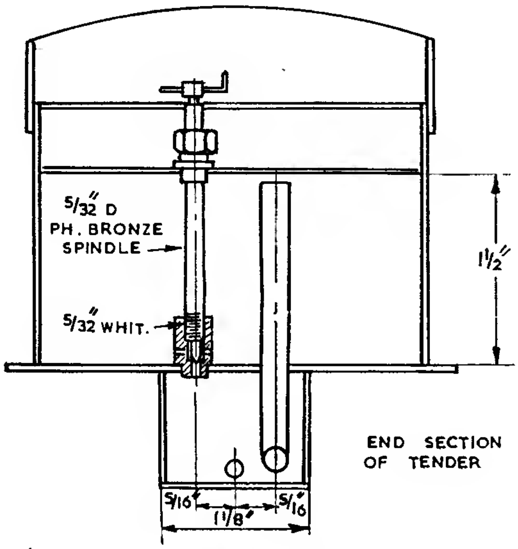
Don't forget the extension handle. This can be made from the ⅛ in. × ¼ in. brass strip, a piece of thin gauge brass being wrapped around one end and soldered to it to fit nicely on the end of the short lever on the pump.

I have not mentioned the engine-to-tender coupling. This depends a good deal on the radii of the curves the locomotive is likely to negotiate. But a strip of brass about ¼ in. × 3/32 in. will be plenty strong enough, and a 3/32 in. steel split pin can be used, through the tender drag beam, to connect things up.

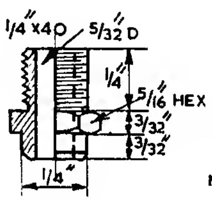


Ready for the road

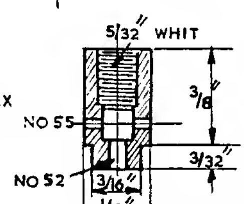
The buffers and couplings have already been described—being the same as on the engine—and the final trimmings such as brake pipe, steps and hand rails I propose to leave to builders' own preference.



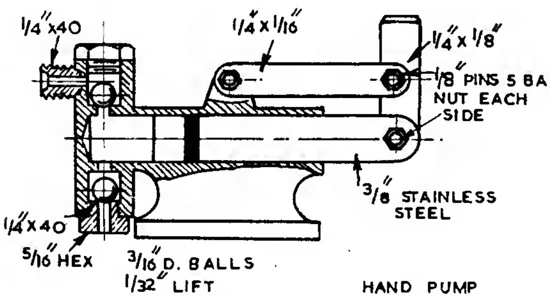
END SECTION OF TENDER



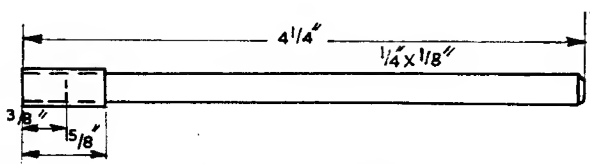
SPIRIT VALVE TOP FITTING



SPIRIT VALVE BOTTOM FITTING



HAND PUMP



PUMP HANDLE EXTENSION

PAINTING

A few notes on painting a model of this type may be of interest. Being a freelance model we shall not be troubled by any fierce Swindon enthusiast pointing the finger of scorn and saying, as they always do—"Now *that's* not GW green!"

I think SR green would look nice on this model, but don't forget that any light shade of green will soon go brown around the boiler due to the heat of the burners, unless the job is properly stoved.

Stoving is, of course, the ideal method for a model of this type, though the fact that several joints are soft-soldered limits the degree of stoving that can be applied.

Synthetic enamels of the Chinese lacquer type, such as Valspar, make a good substitute and stand a small stoving temperature.

The secret of obtaining a good finish is to ensure that the model is really clean before starting operations, to use a good quality brush and not to attempt to cover the job in one coat.

Start off by dismantling those parts that will come away without too much trouble, such as the bogie, driving wheels, axleboxes, coupling rods, etc., and remove the tender body from its frames. Give all parts a good wash in petrol (this is best done outdoors) before starting to paint—I would also say choose a dry day if you possibly can—and apply the first coat of the main body colour chosen with a flat brush about ½ in. wide, sable for preference.

Enamels such as Valspar don't need an undercoat but they usually need a little turpentine. Don't overload the brush nor "work" it too long.

When painting the boiler, run the brush around it, not along it, and always brush away from edges and details rather than towards them if you want the best finish.

Three thin coats should be ample, but be sure they are *really* dry before rubbing down with very fine emery or pumice powder and applying the next coat.

It is also most important that no dust falls on the model while the paint is still wet. A cardboard "tunnel" is a great help here, unless you can enlist the co-operation of the Domestic Authority and borrow the gas oven! By the way, if you do use the gas oven for a mild degree of stoving, have the gas as low as possible and leave the door open a nick. You don't want the result of many weeks or months of hard work to disintegrate in a matter of minutes!

Well, I must draw my story to a close. I hope that I have covered all those points that are likely to arise in the course of construction. From what I hear there are already quite a few *Newburys* under construction in various parts of the country. Good steaming to them! ▣